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Original Article

Comparative Evaluation of Changes in Salivary pH in Patients using Povidone Iodine Mouthwash versus Chlorhexidine Mouthwash during the Non-surgical Periodontal Therapy of Chronic Periodontitis Patients: A Randomized Clinical Study

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Abstract

Introduction: Saliva contains a variety of host defense factors. It influences calculus formation and periodontal disease. With a multitude of biomarkers and complexities in their determination, the salivary pH may be tried to be used as a quick chairside test.

Materials and Methods: The study was conducted in the outpatient department of the Department of Periodontics and Oral Implantology, DY Patil School of Dentistry, Navi Mumbai, Maharashtra, India. The study population consisted of 40 patients who were between 25 and 60 years in age.

Results: In the inter-group result interpretation, on comparing the means of the gingival index and plaque index, it was not statistically significant. Although when comparing the means of the salivary pH, between the two mouthwashes 2 weeks after its use, the difference in their pH values was statistically significant, where $P < 0.05$ as shown in Table 1, where Group A showed a better and more alkaline pH compared to Group B

Conclusion: Disease severity is strongly correlated to low pH values. Salivary pH is more acidic in periodontal disease conditions, compared to the periodontally healthy subjects where the salivary pH is more alkaline. The salivary pH was more acidic in the periodontitis group which had high gingival and plaque index values compared to periodontally healthy groups showing a positive correlation between pH and GI and PI

Key words: Chlorhexidine mouthwash, Chronic periodontitis patients, Disease progression, Non-surgical periodontal therapy, Periodontitis, Povidone iodine mouthwash, Salivary pH, Severity

INTRODUCTION

Chronic periodontitis is a destructive form of the periodontal disease, in which a long-standing inflammatory state of the supporting structures is seen. After its onset, the disease progresses with the loss of collagen fibers and attachment to the root surface, apical migration of the pocket epithelium, deepening of periodontal pockets, and the increase in alveolar bone resorption. Owing to the nature of this disease, the treatment needs to be quick and efficient, although if left untreated, the disease continues with progressive destruction of the alveolar bone, which in turn leads to increased tooth mobility followed by tooth loss.

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Saliva is also known to be the mirror of the body. Not only is it used to monitor the general health but also the beginning of specific diseases. Biomarkers produced by both healthy individuals or by individuals affected by specific systemic diseases are sure-shot indicators that can be used to not only monitor the health status and disease onset but also the response to the treatment and its outcome. Since saliva plays an important role in the formation of the oral biofilm and host defence, secreted saliva may have a significant role in the establishment and progression of periodontal disease.

Salivary pH plays a very important role as a biochemical indicator in periodontal diseases. This parameter is defined as the degree of acidity or alkalinity of an aqueous solution. Since periodontal disease is characterized by the changes in the periodontium, such as inflammation, bleeding, bone loss, etc., it is feasible to believe this pathology modifies the properties of saliva including its pH. It is buffering action, facilitates it to maintain a neutral pH range (6.5–7.2) in the oral cavity, however, the salivary pH has been modified under the pathological conditions.

Due to these various reasons, it can be said that the salivary pH is altered in patients with periodontitis and returns to its normal range after periodontal treatment. Therefore measuring the pH of the saliva can serve as a complementary parameter for diagnosing and monitoring the periodontal health in patients with periodontal disease.[1]

Hence, this study is planned to comparatively evaluate the change in salivary pH in patients before and after the use of two mouthwashes, namely chlorhexidine 0.2% and povidone iodine 10% during the non-surgical therapy of chronic periodontitis patients.

MATERIALS AND METHODS

The study was conducted in the outpatient department of the Department of Periodontics and Oral Implantology, DY Patil School of Dentistry, Navi Mumbai, Maharashtra, India. The study population consisted of 40 patients who were between 25 and 60 years in age. They were divided into two groups:

- Group A - 20 participants who were given povidone iodine mouthwash
- Group B - 20 participants who were given chlorhexidine mouthwash.

The study inclusion criteria included subjects in the age group of 25–60 years, at least 20 teeth had to be in the oral cavity, bleeding on probing present, mild to moderate chronic periodontitis patients with pockets depth up to 5 mm, each quadrant having at least 2–3 sites with pocket depth up to 5 mm, no clear allergy to any of the components of the mouthwashes, subjects with periodontitis: Generalized chronic periodontitis diagnosed according to the AAP International Workshop for Classification of Periodontal Diseases, 1999.

The exclusion criteria involved patients under the age of 25 years, undergoing periodontal treatment in the past 6 months, with systemic diseases that could have influenced the therapy (patients with thyroid dysfunction, diabetes mellitus, cancer, osteoporosis, radiotherapy, and anticoagulant therapy), gingivitis patients, with mental or physical retardation that could have influenced the domestic oral hygiene, uncooperative patients, smokers, pregnant or lactating women, patients with salivary flow disorders such as xerostomia or pathology in salivary glands, subjects under medication that may affect salivary function or composition and uncooperative patients and those unwilling to sign the consent form.

The patients were explained in detail about the procedure and were made aware of the purpose of study. All the questions asked by the patients pertaining to the study were answered to the satisfaction of each patient to ensure co-operation.

The following clinical indices and parameters were recorded: Gingival index (Loe and Silness, 1963), plaque index (Turesky, Gilmore, Glickman modification of the Quigley Hein plaque index, 1970), and salivary pH.

After getting the written informed consent, all the subjects who participated in the study were subjected to measurement of clinical indices including Gingival Index and Plaque Index, followed by saliva sample collection from both groups. The first saliva sample was collected at baseline from both the groups after which non-surgical periodontal therapy was carried out on the same day (T0) for all the subjects in Group A and B. The patients were asked to use their respective mouthwash for 2 weeks and were then recalled (T1). The second saliva sample was collected from Group A and Group B 2 weeks after the first sample was collected, following which salivary pH assessment was carried out.

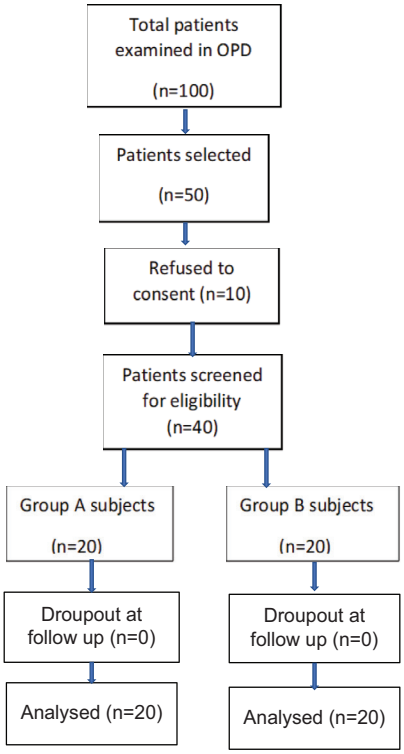
Saliva samples were obtained in the morning after an overnight fast, during which subjects were requested not to drink any beverages except water.

On the day of sample collection, subjects were given drinking water and were asked to rinse their mouth out well. 5 min after this oral rinse, the subject was asked to spit whole saliva. The participants were asked to refrain from talking and drop down the head and let the saliva run naturally to the front of the mouth. The subjects were also asked not to cough up mucus as saliva is collected. The subjects spit into the collection tube about once a minute for up to 10 min.

5 ml of saliva was collected in sterile 10 ml beaker. The saliva sample is collected between 9:00 am and 11:00 am following which the pH of saliva is immediately measured.

The table top pH meter Equiptronics, model EQ-610 manufactured by Equiptronic instruments was used for measuring the pH of saliva the device was standardized in pre-prepared buffer solutions of pH 4.01 and pH 9.18 to avoid any inaccuracies.

RESULTS



No subjects were lost during the 2-week follow-up, and all of them were included in the statistical analyses. No uneventful events were observed.

Table 1: Comparison of the mean difference (baseline – after 2 weeks) in terms of (mean [SD]) of plaque index values, gingival index values, and salivary pH level among both the groups using the unpaired *t*-test

Variables	Group	*n*	Mean	Standard deviation	*t* value	*P*-value
Plaque index	Group A	20	0.3200	0.19084	1.031	0.309
	Group B	20	0.3700	0.10311		
Gingival index	Group A	20	0.3100	0.19167	0.857	0.397
	Group B	20	0.3550	0.13563		
Salivary pH	Group A	20	0.1940	0.06901	2.915	0.006*
	Group B	20	0.1380	0.05116		

P<0.05 - Significant*, *P*<0.001 - Highly significant**. SD: Standard deviation

In the inter-group result interpretation, on comparing the means of the gingival index and plaque index, it was not statistically significant. Although when comparing the means of the salivary pH, between the two mouthwashes 2 weeks after its use, the difference in their pH values was statistically significant, where $P < 0.05$ as shown in Table 1, where Group A showed a better and more alkaline pH compared to Group B; hence, we can conclude that the use of povidone iodine mouthwash was more effective and changed the salivary pH to a more alkaline pH [Figures 1-3].

DISCUSSION

The pH of bodily fluids, namely blood and saliva, play a very important role in maintaining the health of an individual.[1] It is known that even a minor alteration as small as 0.1 in the salivary pH toward acidity which in turn increases the risk of caries. This is in accordance with an article by Pozhartiskaya *et al.* where it was concluded that changes in salivary pH are closely related to the caries resistance properties of saliva and greatly impact the clinical parameters such as probing pocket depth, clinical attachment level, gingival index and plaque index, along with the disease severity in chronic periodontitis patients. This could be attributed to the fact that a reduced salivary pH can increase the production of the reactive oxygen species, which in-turn leads to an increase in periodontal destruction.[2]

Moreover, Chlorhexidine mouthwash and Povidone iodine mouthwash are both widely used in dentistry, due to their excellent antimicrobial properties, Chlorhexidine mouthwash known to be a gold standard,[3] although very scarce studies have been carried out comparing the effect of these two mouthwashes on the salivary pH and their role in it's alteration.

Chronic periodontitis patients with pockets upto 5 mm were chosen, which was in accordance with studies carried out by Heitz and Lang in 2001 and by Pal *et al.* in 2021, who put forward the concept of critical probing depth of 5.4 mm, which means that a probing depth of above 5.5 mm, would benefit from additional surgical therapy, while sites with a shallower probing depth require only non-surgical therapy.

In the oral cavity, the pH is maintained near neutrality by saliva, but studies have shown that patients with periodontal disease tend to have a more acidic pH, which is similar to the findings in this study. This can be due to the presence of bacteria such as *Porphyromonas gingivalis* which has its proteolytic activity at pH 5–5.5, which directly mediates vascular damage *in vivo* by degrading endothelial adhesion,

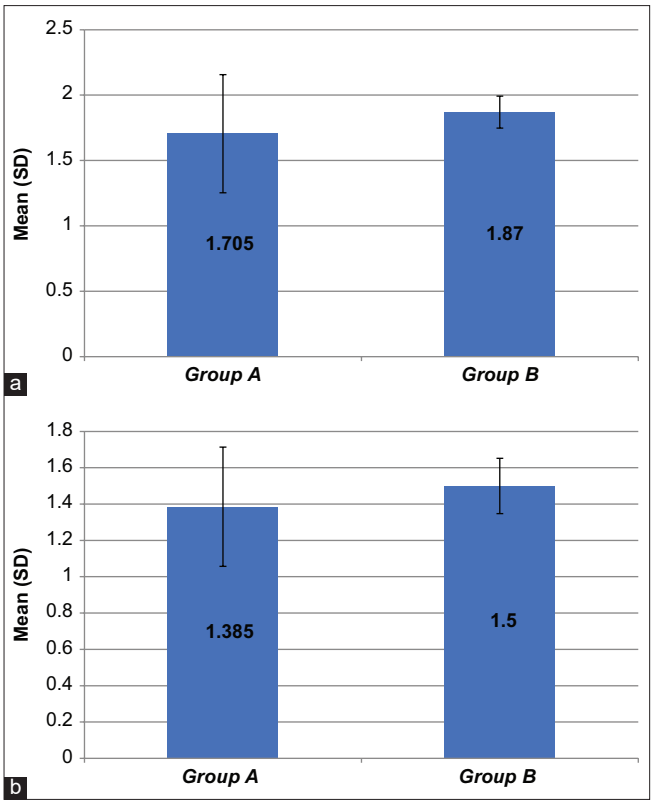


Figure 1: Comparison of plaque index values in terms of (mean [SD]) at different time intervals among both the groups using unpaired *t*-test. (a) Baseline, (b) after 2 weeks

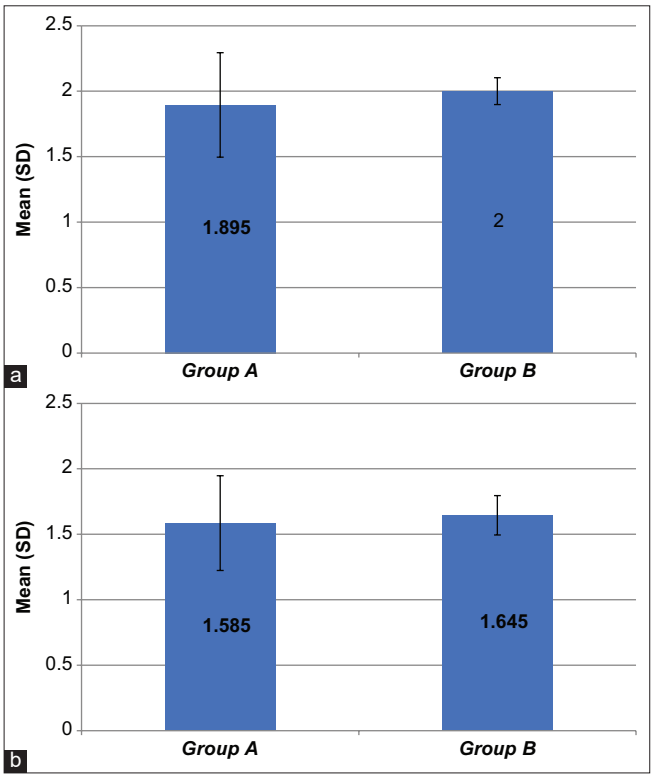


Figure 2: Comparison of gingival index values in terms of (mean [SD]) at different time intervals among both the groups using unpaired *t*-test. (a) Baseline, (b) after 2 weeks

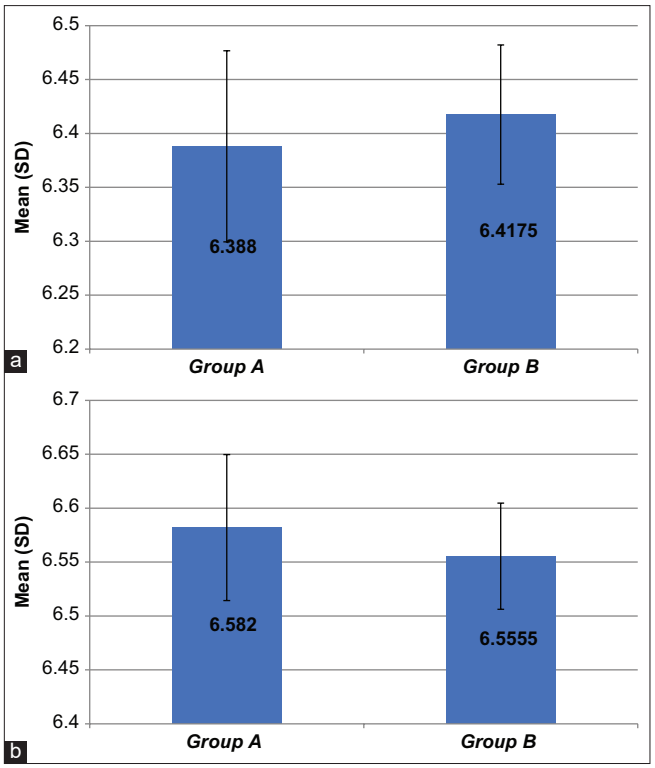


Figure 3: Comparison of Salivary pH values in terms of (mean [SD]) at different time intervals among both the groups using unpaired *t* test. (a) Baseline, (b) after 2 weeks

thus increasing vascular permeability and modulating leucocyte recruitment at the endothelial surface.[4] The local inflammation enhances cytokine and other inflammatory markers[5] which promotes the further destruction of periodontal tissue.

Saliva is used as a diagnostic fluid for a variety of reasons, namely- it meets the demands for being inexpensive, non-invasive and easy-to-use diagnostic tool.[1] As a clinical tool, saliva has many advantages over serum, including ease of collection, storing and shipping and it can be obtained at a low cost in sufficient quantities for analysis. For patients, the non-invasive collection techniques drastically reduces discomfort and anxiety making it easy to obtain repeated samples for monitoring over time. Also in diagnostic procedures, saliva is easier to handle because it does not clot, thus reducing the manipulations required.[1]

In the intergroup comparison there was a statistically significant difference ($P < 0.05$) seen in the salivary pH between the 2 groups after phase I therapy, where patients in Group A using Povidone iodine mouthwash showed a more favourable result, with a less acidic pH.

This is in accordance with a study conducted by Shin and Nam in 2018,[6] where as a result, the pH of saliva was elevated after CHX and PVI gargling, and a significant

increase was also shown in the comparison of the groups. The CFU of *S. mutans* decreased with gargling in the order of PVI and CHX. Based on this study, PVI caused the most effective change in the oral environment followed by CHX. This result is consistent with our study that gargling is an effective method for plaque control in the oral cavity as it increases the pH of saliva toward alkalinity in pre-operative patients.

This shows the direct relation between the presence of periodontal disease and the changes in salivary properties such as pH.

This gives enough reason to use saliva pH as a diagnostic tool in the prediction and follow-up of periodontal disease.

CONCLUSION

The following conclusions may be drawn from our study:

- Disease severity is strongly correlated to low pH values.
- Salivary pH is more acidic in periodontal disease conditions, compared to the periodontally healthy subjects where the salivary pH is more alkaline.
- The salivary pH was more acidic in the periodontitis group which had high gingival and plaque index values compared to periodontally healthy groups showing a positive correlation between pH and GI and PI.
- There is a definite improvement seen in the salivary pH after periodontal therapy bringing the pH of saliva towards a neutral pH.
- Even a minor variation as small as 0.1 in the pH of the saliva can greatly impact the pocket probing depth, clinical attachment level and disease severity, hence utmost care was taken to record the slightest change in pH.
- Mouthwashes play an important role in maintaining the oral hygiene and health of the oral cavity.
- Both povidone iodine 10% and Chlorhexidine 0.2% are equally effective in reducing the gingival index, plaque index, pocket-probing depth, and clinical attachment levels.
- Povidone iodine 10% when used as a mouthwash is more effective in raising the salivary pH, when compared to 0.2% Chlorhexidine mouthwash, thus making it a more efficient mouthwash in the treatment of chronic periodontitis.

Limitations

The present study includes the following limitations:

- Future studies with a larger number of participants are required.
- Subjects were re-evaluated 2 weeks after treatment; long-term follow-ups after treatment is necessary for better insights into salivary pH levels and disease severity.
- Our study results are entirely dependent on patient compliance and if they have strictly abided by the instructions given regarding the frequency of the use of the respective mouthwash.
- pH meter used in the present study is expensive compared to the use of pH strips for assessing saliva pH.
- As values of pH are extremely sensitive to the instrument used, if the pH meter is not cleaned regularly according to the manufacturer's instructions, it can lead to contamination of the saliva sample and can give altered results.

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