Non-surgical periodontal therapy: Does it affect the salivary pH?

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Abstract

Objectives: The aim of this study was to assess the salivary pH in periodontally healthy and periodontally diseased patients before, immediately after and one week after non-surgical periodontal therapy.

Methodology: A total of 380 patients who met the inclusion criteria of the study were selected for this study and were grouped as Healthy, Gingivitis and Periodontitis patients. A self-designed proforma was used to record the collected data. Salivary pH was recorded at the sublingual area using pH testing strips at baseline, immediately and one week post non-surgical periodontal therapy (NSPT). The patients were divided into three groups as group A, B and C. In group A, periodontally healthy patients were placed whereas in group B and C, patients with gingivitis and periodontitis were placed, respectively.

Results: The pH values recorded immediately after NSPT was significantly higher as compared to pH values recorded pre-operatively among health and diseases groups. The pre-operative pH values were significantly higher when compared with pH values recorded one week after procedure among health and diseased groups. The saliva pH values of a healthy group were significantly higher at all intervals when compared to diseases group.

Conclusion: It is concluded from the study that NSPT has definite role in elimination of acid producing bacteria which subsequently helps in shifting the acidic oral environment towards healthy environment.

Keywords: Salivary pH, Periodontal Disease, Non-surgical Periodontal therapy

Introduction

Saliva is a convoluted oral fluid which has a great impact on oral health through widespread physical and chemical properties (1). Besides, many other functions, very essential role saliva plays are maintenance of pH of a mouth through its buffering capability. The saliva maintains the pH by employing two mechanisms; the salivary flow removes fermentable carbohydrates and sugars that could be metabolized by bacteria and reduces acids produced by acidogenic bacteria and acidity from drinks and foods, as well as from bacterial activity, is neutralized by the buffering activity of saliva (2).

Average salivary pH ranges between 6.2-7.6 (3). Normal production of saliva is 0.5 to 1.5 liter per day in a healthy mouth and its flow rate 1 ml/min or less is considered low (4). The flow rate is influenced by circadian rhythms, physical activity and general and oral health status of an individual (5).

Periodontal diseases are considered Plaque-based diseases while plaque is an invisible oral biofilm that collects on the surfaces of teeth and gingival junction (6). More than 500 bacterial species have been identified in a biofilm and their colonization in the biofilm follows a disciplined pattern. A highly tenacious layer is first deposited called as salivary pellicle which adheres early bacterial flora followed by secondary colonization through interbacterial adhesion. An array of adhesins (cell-surface components which help in adhesion) and molecular interactions initiate these adhesive interactions and participate in the biofilm growth and ultimately give rise to periodontal disease (7). The biofilm becomes visible within 5 days after its formation and manifests clinical signs of localized gingivitis whereas generalized gingivitis becomes evident in another 15-20 days.

Deposition of the biofilm which contains acid-producing and acid resistant bacteria along with gram negative anaerobic bacteria, pH of saliva tends to fall from slightly alkaline towards acidity. It has been revealed by research studies that in gingival and periodontal diseases, the salivary pH becomes acidic (8). Researchers of another similar clinical study found very conflicting results. It describes that among 150 patients, there was a statically significant increase in salivary pH value and other parameters as the condition proceeded from health to gingivitis or periodontitis (9).

Findings of another related study were between the findings of the two above mentioned studies. It mentions that patients suffering from chronic periodontitis have more acidic salivary pH than healthy group but patients with gingivitis show alkalinity in saliva pH as compared to healthy group (3).

Periodontal diseases are treated by the reduction of pathogens entrenched in the supra gingival and subgingival biofilm (10). The Subgingival microbiota consists of three regions of well-defined microorganisms; the ones located on the dental surface, the ones associated with the pockets gap and the ones adhered to the pocket wall (11).

Meticulous NSPT is considered gold standard for the treatment of Periodontitis and has been shown to improve pocket depths and clinical parameters in mild to moderate periodontal conditions (12). NSPT includes both mechanical and chemotherapeutic strategies to minimize bacterial biofilm. Mechanical therapy implies scaling and debridement of the root surfaces with hand or power-driven scalers to remove this bacterial biofilm, their toxins and other plaque retentive elements (13).

The most frequent bacteria in the subgingival plaque include Gram +ve Cocci as Streptococci sanguis, constellatus, mitis, mobillorum, intermedius,

Staphylococci epidermidis, Lactobacilli casei, acidophilus, Gram positive rods, actinomyces as Actinomyces viscosus, odontolyticus, naeslundii, Capnocytophaga gingivalis, ochracea, fusubocterium (14). In an in vitro study its authors showed that species of the genus Bifidobacterium adhere strongly to the subgingival biofilm and its count plays role in periodontal health and disease (15). Most of these microbes are acidogenic specially streptococci show a high rate of acid production and survive for being acid resistant and continue to produce acids in low pH environment (16). It is hypothesized that if the load of acid producing bacteria is minimized from gingival and periodontal tissue through NSPT, the oral environment should show tendency to become alkaline. The salivary pH of a person undergoing NSPT should show more alkalinity after NSPT than before instituting the NSPT.

The outcomes of the studies presented to evaluate the pH of saliva are not only confusing but also extremely contradictory. Moreover, to the best of our knowledge no study has been conducted on Pakistani population evaluating the pH of saliva in healthy and diseased subjects receiving nonsurgical periodontal treatment.

This study was designed to evaluate possible correlation in salivary pH in periodontally healthy, gingivitis and in periodontitis patients at baseline, immediately and one week after NSPT.

Methodology

A longitudinal randomized perspective clinical trial was carried out in the outpatient department of Periodontology of a dental hospital attached to the dental college of a private medical university in cosmopolitan city of Karachi. After approval from the ethics committee (REF # BDC/ERB/2020/007) patients were enrolled from August 2017 to February 2018. A sample size of 380 subjects with ages varying between 18 to 70 years was considered for the study. Subjects; with healthy periodontium and diseased periodontium (gingivitis and periodontitis) having at least 20 caries free teeth present in the mouth were incorporated in the study. Individuals with any systemic illness or medical conditions which can have a direct influence on the periodontium or salivary pH such as diabetes mellitus, hypertension, renal or hepatic diseases, arthritis, salivary gland diseases, malignancies or immunodeficiency, pregnant and lactating females, denture wearers and current /past tobacco users, patients on antibiotics or those who had taken in past three months, antifungal or immunosuppressive medications, were excluded from the study.

The purpose of this research and the entire procedure was explained to the eligible subjects and a written consent was obtained from each of them. A self-designed form was used to record demographic data, past medical and dental history and the salivary pH values for each individual. Complete oral examination was performed and the screening of the patients was carried out in accordance with the basic periodontal examination after which they were scored and placed into the three groups with 50 subjects in each and were evaluated at base line, post-operative immediate and post-operative one-week NSPT.

In Group A: Periodontally healthy individuals requiring NSPT for stains and slight hard deposits, Group B: patients with Gingivitis requiring NSPT, and Group C: patients with Periodontitis requiring NSPT were placed.

Basic periodontal Examination (BPE) was done using a CPITN probe and mouth mirror and the entire dentition was divided into six sextants as recommended by the British Society of Periodontology. The probe was walked around the gingival crevice of all teeth in all the sextants. Bleeding on probing and pocket depths were evaluated and the highest score in each sextant was recorded on the

basis of which patients were segregated and placed in the respective group.

Salivary pH was recorded in the morning between 10am to 1pm. Once the screening was carried out and diagnosis was established, saliva collection was done. The patients were provided bottled drinking water to rinse their mouths and were instructed to wait for 30 minutes during which they were not allowed to eat, drink, chew or smoke. Unstimulated saliva was assessed by inserting pH testing color changing strips (MColorpHastin, MilliporeSigma & USA) in the oral cavity of each participant sublingually. The pH values were recorded in the data sheet as the baseline data. Patients with periodontal disease were provided with single visit full mouth scaling and root planing treatment using ultrasonic scaler and curettes whereas healthy subjects were provided with supra and subgingival scaling to remove plaque and calculus deposits. They were asked to rinse their mouth again and to wait for another 30 minutes. Reevaluation was carried out using the same strip, method and recorded as immediate postoperative pH values. Patients in all three groups were given oral hygiene instructions and were recalled after one week for reevaluation. Till next appointment, they were instructed not to use any antibiotics or mouthwashes. Same protocol was repeated to record saliva pH as post-operative one week.

Statistical analysis

Data analysis was carried out by using SPSS version 17. Initially, descriptive statistics and cross-tabulation were carried out. The repeated-measures ANOVA was conducted to compare pre-operative pH values with post-operative intervals within healthy and diseased groups. Independent sample t-test was conducted to compare mean pH values of a healthy group with diseased groups on pre-operative and post-operative intervals. A significant difference was considered with $p < 0.05$.

Results

In this study, most participants were male of age 18-30 years-old (Table 1). The highest mean pH values of saliva were observed immediately after procedure among healthy and diseases groups (Table 2). The pH values recorded immediately after the procedure was significantly higher as compared to pH values recorded pre-operatively among health and diseases groups. The pre-operative pH values were significantly higher when compared with pH values recorded one week after procedure among health and diseased groups (Table 3). The saliva pH values of a healthy group were significantly higher at all intervals when compared to diseases group (Table 4).

Table 1: Demographic Distribution of the participants

	Age in years				
	18-30	31-40	41-50	51-60	Total
Gender	N (%)	N (%)	N (%)	N (%)	N (%)
Male	204 (53.7)	26 (6.8)	0	0	230(60.5)
Female	0	64 (16.8)	50 (13.2)	36 (9.5)	150(39.5)
Total	204 (53.7)	90 (23.7)	50 (13.2)	36(9.5)	380 (100)

Table 2: Mean pH values of healthy and diseased groups recorded on different intervals

Progress	Healthy Gums Mean (SD)	95% Confidence Interval Lower Bound	Confidence Upper Bound	Gingivitis Mean (SD)	95% Confidence Interval Lower Bound	Confidence Upper Bound	Periodontitis Mean (SD)	95% Confidence Interval Lower Bound	Confidence Upper Bound
Pre-operative	6.90±0.06	6.896	6.908	6.67±0.03	6.667	6.674	6.52±0.03	6.518	6.524
Immediately post-operative	7.12±0.02	7.121	7.125	6.95±0.04	6.946	6.955	6.94±0.02	6.938	6.943
1-week post-operative	6.77±0.02	6.768	6.772	6.64±0.05	6.635	6.645	6.31±0.01	6.313	6.317

Descriptive analysis

SD: Standard deviation

Table 3: Comparing pre-operative pH values with post-operative intervals within healthy and diseased groups

	Pre-operative VS Immediately post-operative Mean Difference	95% Confidence Interval for difference Lower Bound	Upper Bound	P value	Pre-operative VS 1-week post-operative Mean Difference	95% Confidence Interval for difference Lower Bound	Upper Bound	P value
Healthy Gums	.221	.229	.213	.0001	.132	.124	.140	.0001
Gingivitis	.280	.287	.273	.0001	.031	.022	.040	.0001
Periodontitis	.419	.424	.414	.0001	.206	.202	.210	.0001

Repeated measures ANOVA

Table 4: Comparison of mean pH values of a healthy group with diseased groups on pre-operative and post-operative intervals

Progress	Healthy Gums VS Gingivitis Mean Difference	95% Confidence Interval for difference Lower Bound	Upper Bound	P value	t(df)	Healthy Gums VS Periodontitis Mean Difference	95% Confidence Interval for difference Lower Bound	Upper Bound	P value	t(df)
Pre-operative	0.231	0.223	0.238	.0001	63(621)	0.380	0.373	0.387	.0001	108(564)
Immediately post-operative	0.172	0.167	0.176	.0001	73(559)	0.182	0.185	0.178	.0001	106(713)

1-week post-operative	0.455	0.124	0.135	.0001	45(543)	0.130	0.458	0.451	.0001	284(734)

Independent sample test

t value

df: degree of freedom

Discussion

There are various factors that affect quality and quantity of the saliva which include oral hygiene, systemic diseases, use of certain medications and habits such as smoking and alcohol consumption (9). The patients with systemic diseases and those taking medication were therefore, excluded from the study as some researchers state that patients taking antidepressants, anxiolytics, diuretics and antihypertensive medicines have a lower levels of salivary flow that affects pH of the saliva (17). In a study, there was a lower level of pH recorded in individuals having hypertension and diabetes (18). Complete denture wearer were also ineligible for the study as denture wearers frequently experience xerostomia, candidiasis and stomatitis and more plaque accumulation which can alter the pH of the oral cavity. Individuals in the habit of using betelnut, arecanut, wine, tobacco chewing or smoking were not made part of the study as long-term effects of these products render oral mucosa predisposed to oral diseases and acidic pH (19).

In a clinical study, a patient suffering from periodontitis received NSPT followed by Surgical Periodontal therapy. The author reported that periodontal disease is the cause of drop in the salivary pH and periodontal treatment does have a favorable effect on salivary pH. Moreover, the NSPT have been found to improve salivary enzymatic activity and antioxidants levels in saliva. The results of a study disclosed that the activities of MPO enzyme were significantly increased in the saliva of patients with periodontal disease in comparison to healthy individuals and NSPT was found very effective in improving the most

clinical parameters and in reducing salivary enzymatic activity (20). Findings of another study demonstrate that the level of salivary antioxidants in patients with moderate to severe periodontitis significantly increased after periodontal therapy which indicates beneficial impact of NSPT on the level of salivary antioxidants in patients having periodontitis (21).

However, in our study scaling and root planing was the only treatment provided to the patients but findings of both the studies match and confirm that after periodontal treatment; may it be surgical or non-surgical, salivary pH shifts towards alkalinity. According to author of a study, the critical part of periodontal therapy is not the choice between a surgical or a nonsurgical procedure, but in fact, it is a meticulous and comprehensive professional cleaning and consequent reduction of microbiota that matters (22).

Results of our study reveal that there was significant difference in baseline and immediately post-operative salivary pH values but 1-week post- operative show less alkalinity in saliva. The logical reason behind it may be reduction of microbiota that persists between 14 -180 days immediately after the therapy but generally, it is observed on the subsequent visit after scaling and root planing that patients forget to perform required home dental care though the literature gives extensive recommendations for maintaining the results of successful NSPT (23). This lack of patient's interest encourages plaque retention which makes the saliva less alkaline than immediately after NSPT. The non-compliance from patients in this regard have been documented in many oral hygiene studies (24,

25). Another reason for pH change may be lower status of polishing after scaling and root planing which leaves roughened areas behind. A study done to establish association between surface roughness and saliva pH showed that due to roughened surface, pH was increased in comparison to polished surfaces (26). It is our usual observation that rough surfaces nurture and retain more plaque than a polished surface.

A study was conducted to investigate possible correlation between salivary pH, gingivitis and periodontal pocket. Correlation between pH and periodontal pocket was evident (27) which supports the findings of the current study but regarding association between pH and gingivitis our findings do not match with it as saliva pH values in our study were significantly more alkaline than baseline values. On the contrary, one study mentioned that the mean levels of biomarkers including saliva pH significantly elevated as the condition proceeded from health to gingivitis or periodontitis (9). These findings contradict the findings of the current study in all respects.

Results regarding low pH in periodontal diseases in current study are similar to another study which observed that salivary pH in obese patients having periodontitis was significantly lower than healthy persons (28). A study conducted on diabetics and non-diabetics having periodontitis revealed that saliva pH was lower in individuals suffering from periodontitis without diabetes mellitus and even further lower in patients with periodontitis and diabetes mellitus (29). The results of the study support the findings of the current study.

Conclusion

It is concluded from the study that NSPT has definite role in elimination of acid producing bacteria which subsequently helps in shifting the acidic oral environment towards healthy environment. It is but recommended that once the active bacterial load and host inflammatory reactions have been controlled by surgical or non-surgical periodontal therapy, it is exceedingly essential for the patient to maintain periodontal health with routine plaque control measures at home and periodic maintenance by a dental professional.

Abbreviation

NSPT: Non-surgical Periodontal Therapy

BPE: Basic Periodontal examination

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