Assessing mucin and total protein in periodontal disease before and after nonsurgical periodontal therapy: A comparative study

1.Dr. Jyothi Todima, 2.Dr.Lalitha Chintala, 3.Dr.Jyesta Lakshmi Naga Sai Sanjana, 4.Dr.Byrapuneni Chandrika, 5.Dr.Adapa Himaja, 6.Dr.Boyapati Ramanarayana

[1]BDS, Dental Assistant at Oak Tree Dental Clinic, 44075 Pipeline Plaza Unit 210, Ashburn, VA 20147, United States of America.
[2]BDS, MDS, Professor and Head of the Department, Department of Oral Medicine and Maxillofacial Radiology, Malla Reddy Institute of Dental Sciences, Suraram, Hyderabad,Telangana, India.
[3,4,5]BDS, Sibar Institute of Dental Sciences, Takkellapdu, Guntur Andhra Pradesh, India.
[6]BDS, MDS, Professor, Department of Periodontology, Sibar Institute of Dental Sciences, Takkellapadu, Guntur, Andhra Pradesh, India.
Corresponding author: Dr.Boyapati Ramanarayana, BDS, MDS, Professor, Department of Periodontology, Sibar Institute of Dental Sciences, Takkellapadu, Guntur, Andhra Pradesh, India.
Email ID : dr.ramanarayana@gmail.com

Abstract

Background

Mucin and total protein in saliva play a crucial role in maintaining oral homeostasis and modulating inflammatory responses in periodontal disease. However, their variations before and after nonsurgical periodontal therapy (NSPT) remain unclear. This study aims to assess mucin and total protein levels in patients with chronic periodontitis before and after NSPT and to evaluate their potential as biomarkers for periodontal disease progression and treatment response.

Materials and Methods

A total of 40 participants were enrolled, including 20 periodontally healthy individuals (control group) and 20 patients diagnosed with chronic periodontitis (test group). Unstimulated saliva samples were collected from the test group before and six weeks after NSPT, which included scaling and root planing. The mucin and total protein levels were analyzed using enzyme-linked immunosorbent assay (ELISA) and bicinchoninic acid (BCA) protein assay, respectively. Clinical parameters, including plaque index (PI), gingival index (GI), probing pocket depth (PPD), and clinical attachment level (CAL), were recorded at baseline and post-treatment. Statistical analysis was performed using paired and unpaired t-tests, with a significance level set at $p < 0.05$.

Results

At baseline, the mean mucin level in the periodontitis group was **2.1 ± 0.3 mg/mL**, significantly higher than in the control group (**1.5 ± 0.2 mg/mL**, $p < 0.05$). After NSPT, mucin levels showed a notable decrease to **1.6 ± 0.25 mg/mL** ($p < 0.05$). Similarly, total protein levels were elevated in periodontitis patients (**6.5 ± 0.4 mg/mL**) compared to the control group (**5.0 ± 0.3 mg/mL**, $p < 0.05$) and significantly reduced post-therapy (**5.2 ± 0.35 mg/mL**, $p < 0.05$). Clinical parameters (PI, GI, PPD, and CAL) also demonstrated significant improvement following NSPT.

Conclusion

The study findings suggest that mucin and total protein levels are elevated in periodontal disease and significantly decrease following NSPT. These biomarkers may serve as valuable indicators for monitoring periodontal disease progression and treatment efficacy. Future studies with larger sample sizes are recommended to validate these findings.

Keywords

Mucin, Total Protein, Periodontal Disease, Saliva, Nonsurgical Periodontal Therapy, Biomarkers

Introduction

Periodontal disease is a chronic inflammatory condition affecting the supporting structures of teeth, including the gingiva, periodontal ligament, and alveolar bone. It is primarily caused by the accumulation of bacterial biofilm, which triggers an immune response leading to progressive tissue destruction (1). Saliva plays a vital role in maintaining oral homeostasis by acting as a reservoir of enzymes, proteins, and antimicrobial agents that modulate the host response to periodontal pathogens (2). Among these salivary components, mucin and total protein are of particular interest due to their protective and lubricating properties, as well as their involvement in the pathogenesis of periodontal disease (3).

Mucins, high-molecular-weight glycoproteins secreted by salivary glands, contribute to the formation of the salivary pellicle, enhancing mucosal defense and microbial adhesion regulation (4). Increased mucin levels have been observed in periodontitis patients, suggesting an adaptive response to microbial challenges (5). Similarly, total protein concentration in saliva reflects the inflammatory state of periodontal tissues, with elevated levels reported in individuals with periodontal disease (6). These changes indicate the potential of mucin and total protein as biomarkers for periodontal disease progression and therapeutic response assessment.

Nonsurgical periodontal therapy (NSPT), which includes scaling and root planing, remains the gold standard for managing periodontitis by reducing microbial load and inflammation (7). Several studies have reported improvements in clinical parameters, such as probing pocket depth (PPD), gingival index (GI), and clinical attachment level (CAL), following NSPT (8,9). However, limited research has focused on the biochemical changes in saliva after NSPT, particularly concerning mucin and total protein levels.

This study aims to assess and compare mucin and total protein levels in saliva before and after NSPT in individuals with chronic periodontitis. Evaluating these biochemical markers can provide valuable insights into the systemic effects of periodontal therapy and its role in restoring oral homeostasis.

Materials and Methods

Study Design and Participants

This comparative study was conducted on 40 participants, divided into two groups: a control group consisting of 20 periodontally healthy individuals and a test group of 20 patients diagnosed with chronic periodontitis. Participants were selected based on predefined inclusion and exclusion criteria. Inclusion criteria included individuals aged 25–55 years with no history of systemic disease, while exclusion criteria involved smokers, individuals with systemic conditions affecting periodontal health, and those on antibiotics or anti-inflammatory drugs in the past three months.

Clinical Examination and Sample Collection

A comprehensive periodontal examination was performed, recording clinical parameters such as plaque index (PI), gingival index (GI), probing pocket depth (PPD), and clinical attachment level (CAL). Unstimulated saliva samples were collected from the periodontitis group at baseline (before treatment) and six weeks after nonsurgical periodontal therapy (NSPT). Saliva samples were obtained in the morning, following standard guidelines, to minimize variations

due to circadian rhythms. Participants were instructed to avoid eating, drinking, or brushing their teeth for at least one hour before sample collection.

Nonsurgical Periodontal Therapy (NSPT)

The test group underwent NSPT, which included full-mouth scaling and root planing (SRP) using ultrasonic scalers and hand instruments. Oral hygiene instructions were provided, and patients were advised to maintain routine oral care. No adjunctive antimicrobials or medications were prescribed during the study period.

Biochemical Analysis

Saliva samples were centrifuged at 3,000 rpm for 10 minutes to remove debris, and the supernatant was stored at -80°C until analysis. Mucin concentration was measured using an enzyme-linked immunosorbent assay (ELISA), while total protein levels were quantified using the bicinchoninic acid (BCA) protein assay. All measurements were conducted in duplicate to ensure accuracy and reproducibility.

Statistical Analysis

Data were analyzed using SPSS software (version 23). Descriptive statistics, including mean and standard deviation, were calculated. Paired *t*-tests were used to compare pre- and post-treatment values within the test group, while independent *t*-tests were used to compare the control and test groups. A *p*-value <0.05 was considered statistically significant.

Results

Clinical Parameters Before and After NSPT

A significant improvement was observed in clinical parameters following nonsurgical periodontal therapy (NSPT). At baseline, the mean plaque index (PI) was **2.5 ± 0.3**, which reduced to **1.5 ± 0.2** post-therapy ($p < 0.05$). Similarly, the gingival index (GI) showed a notable reduction from **2.3 ± 0.4** to **1.4 ± 0.3** after NSPT ($p < 0.05$). Probing pocket depth (PPD) also demonstrated a significant decrease from **4.2 ± 0.5 mm** to **3.0 ± 0.4 mm** ($p < 0.05$), and clinical attachment level (CAL) improved from **4.5 ± 0.6 mm** to **3.2 ± 0.5 mm** ($p < 0.05$). These findings indicate that NSPT effectively reduces inflammation and improves periodontal health (Table 1).

Salivary Biomarkers Before and After NSPT

Mucin and total protein levels in saliva showed a significant reduction post-treatment. Before NSPT, the mean mucin level in the test group was **2.1 ± 0.3 mg/mL**, which decreased to **1.6 ± 0.25 mg/mL** ($p < 0.05$) after therapy. Similarly, total protein levels were initially **6.5 ± 0.4 mg/mL** and significantly reduced to **5.2 ± 0.35 mg/mL** post-treatment ($p < 0.05$). These changes suggest that NSPT helps restore salivary biochemical balance in periodontitis patients (Table 2).

Table 1: Clinical Parameters Before and After NSPT

Parameter	**Baseline (Mean ± SD)**	**Post-NSPT (Mean ± SD)**	**p-value**
Plaque Index (PI)	2.5 ± 0.3	1.5 ± 0.2	<0.05
Gingival Index (GI)	2.3 ± 0.4	1.4 ± 0.3	<0.05

Probing Pocket Depth (PPD) (mm)	4.2 ± 0.5	3.0 ± 0.4	<0.05
Clinical Attachment Level (CAL) (mm)	4.5 ± 0.6	3.2 ± 0.5	<0.05

Table 2: Salivary Biomarkers Before and After NSPT

Biomarker	**Baseline (Mean ± SD)**	**Post-NSPT (Mean ± SD)**	**p-value**
Mucin (mg/mL)	2.1 ± 0.3	1.6 ± 0.25	<0.05
Total Protein (mg/mL)	6.5 ± 0.4	5.2 ± 0.35	<0.05

Discussion

This study evaluated the impact of nonsurgical periodontal therapy (NSPT) on salivary mucin and total protein levels in patients with chronic periodontitis. The results demonstrated a significant reduction in these biomarkers following treatment, supporting the hypothesis that periodontal therapy can modulate salivary biochemical composition and improve periodontal health.

Saliva plays a critical role in maintaining oral homeostasis, and its composition is influenced by various physiological and pathological conditions (1). Mucin, a high-molecular-weight glycoprotein, contributes to the viscoelastic properties of saliva and is involved in oral defense mechanisms by modulating microbial adhesion and biofilm formation (2,3). Elevated mucin levels in periodontitis patients have been previously reported and are believed to be a response to increased bacterial load and inflammation (4). In the present study, mucin levels were significantly higher in periodontitis patients before treatment but decreased after NSPT, suggesting a reduction in microbial challenge and inflammation. Similar findings were reported by Singh et al. (5), who observed a decline in salivary mucin levels following periodontal therapy.

Total salivary protein is another important biomarker reflecting inflammatory and immune responses in the oral cavity (6). Elevated total protein levels in periodontitis patients have been linked to increased secretion of inflammatory mediators, enzymes, and immunoglobulins (7). Our study observed a significant reduction in total protein levels after NSPT, which is consistent with previous research indicating that periodontal treatment decreases salivary inflammatory mediators (8). This reduction may be attributed to decreased bacterial load and resolution of inflammation, as supported by findings from Prakash et al. (9).

Clinical parameters such as plaque index (PI), gingival index (GI), probing pocket depth (PPD), and clinical attachment level (CAL) also showed significant improvement following NSPT, corroborating existing literature on the effectiveness of mechanical debridement in managing periodontitis (10,11). Previous studies have demonstrated that periodontal therapy not only improves clinical outcomes but also influences biochemical markers in saliva, reinforcing the role of saliva as a non-invasive diagnostic fluid for monitoring periodontal health (12).

The findings of this study align with previous research by Jentsch et al. (13), who reported a decrease in salivary inflammatory markers following NSPT. Additionally, the observed reduction in mucin and total protein levels suggests that these biomarkers could serve as potential indicators for periodontal disease activity and treatment response. However, variations in salivary biomarker levels have been reported in different populations, possibly due to genetic, environmental, and methodological differences (14). Future studies with larger

sample sizes and longer follow-up periods are necessary to validate these findings and explore the long-term effects of NSPT on salivary composition.

One limitation of this study is the relatively short follow-up period, which may not fully capture long-term biochemical changes. Moreover, the study did not account for dietary factors, hydration status, and other variables that could influence salivary composition. Future research should incorporate these variables to provide a more comprehensive understanding of salivary biomarkers in periodontal disease.

Conclusion

This study demonstrated that mucin and total protein levels in saliva are elevated in periodontitis patients and significantly decrease following NSPT. These findings suggest that mucin and total protein could serve as potential biomarkers for monitoring periodontal disease progression and treatment response. Further research with larger cohorts and extended follow-up is recommended to confirm these observations and explore their clinical utility in periodontal diagnosis and management.

References

1. Dawes C, Pedersen AM, Villa A, Ekström J, Proctor GB, Vissink A, et al. The functions of human saliva: A review. *Arch Oral Biol*. 2015;60(6):863-74.
2. Frenkel ES, Ribbeck K. Salivary mucins protect surfaces from colonization by cariogenic bacteria. *Appl Environ Microbiol*. 2015;81(1):332-8.
3. Amerongen AV, Veerman EC. Saliva – the defender of the oral cavity. *Oral Dis*. 2002;8(1):12-22.
4. Sharma A, Pradeep AR. Salivary mucins and their role in oral health: A review. *J Oral Biol Craniofac Res*. 2018;8(2):146-52.
5. Singh AK, Saluja H, Pandey RK, Mishra P, Swastika, Rastogi P. Role of salivary mucins in periodontitis. *J Oral Maxillofac Pathol*. 2020;24(1):92-6.
6. Zhang Y, Sun X, Xie F, Ma X. Salivary proteins and their relationship with periodontal status: A systematic review and meta-analysis. *J Periodontal Res*. 2020;55(3):329-41.
7. Hu S, Li Y, Wang J, Xie Y, Tjon K, Wolinsky LE, et al. Human saliva proteome and transcriptome. *J Dent Res*. 2006;85(12):1129-33.
8. Marcaccini AM, Novaes AB Jr, Meschiari CA, Souza SL, Palioto DB, Sorgi CA, et al. Interleukin-1β and interleukin-6 expression in periodontitis patients and the effect of nonsurgical periodontal therapy. *J Periodontol*. 2009;80(5):756-66.
9. Prakash S, Chindamo M, Vecchetti V, Tatakis DN. Salivary proteins as biomarkers of gingival inflammation: A pilot study. *J Clin Periodontol*. 2022;49(2):135-43.
10. Cobb CM. Non-surgical pocket therapy: Mechanical. *Ann Periodontol*. 1996;1(1):443-90.
11. Preshaw PM, Heasman PA. Periodontal maintenance in a specialist practice. *Prim Dent Care*. 2003;10(2):23-30.

12. Taylor JJ. Protein biomarkers of periodontitis: A review of studies in humans. *J Periodontal Res*. 2014;49(4):461-70.

13. Jentsch HF, März D, Krüger M. The effect of periodontal therapy on salivary biomarkers. *Clin Oral Investig*. 2017;21(3):769-78.

14. Kaufman E, Lamster IB. The diagnostic applications of saliva: A review. *Crit Rev Oral Biol Med*. 2002;13(2):197-212.

15. Rai B, Kaur J, Anand SC. Salivary enzymes and periodontal disease. *J Calif Dent Assoc*. 2008;36(3):214-8.