

EVALUATION OF VITAMIN D SUPPLEMENTATION ON PERIODONTITIS AND OSTEOCALCIN LEVEL AFTER NON-SURGICAL PERIODONTAL THERAPY

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Author's Contribution:

R.N. and A.I. conceived the study and were in charge of overall direction and planning. M.F. and A.K.H. designed the model and the computational framework along with the data analysis. A. and S.A. carried out the implementation. R.N. and A.K.H wrote the manuscript with input from all authors. A.I. performed the calculations.

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ABSTRACT:**Background:**

Vitamin D has anti-inflammatory properties as well as the potential to increase antimicrobial production. A higher intake of vitamin D has also been linked to a lower risk of periodontal disease progression and an increase in Osteocalcin bone mineralization.

Aim:

The primary goal of this study was to evaluate and compare periodontitis clinical parameters before and after oral vitamin D supplementation as adjuvant to Non-surgical Periodontal Treatment as well as to evaluate salivary Osteocalcin bone mineralization levels in chronic periodontitis patients.

Methodology:

This study included 50 patients with periodontitis divided into two groups of 25 patients in each group, Group I receiving only nonsurgical periodontal therapy and Group II receiving both nonsurgical periodontal therapy and vitamin D supplementation. Clinical parameters included plaque index, gingival index, probing pocket depth, clinical attachment loss and Osteocalcin level. Serum vitamin D levels were measured at baseline and 6 weeks after Nonsurgical Periodontal Therapy.

Results:

At 6 weeks, the inter-group comparative of clinical parameters (PI, GI, PPD, and CAL) for both groups revealed statistical significance. In both groups, an intra-group comparative of clinical parameters from baseline to 6 weeks revealed a statistically significant reduction. The Osteocalcin level in the test group increased significantly following vitamin D supplementation as an adjuvant to nonsurgical periodontal treatment.

Conclusion:

A highly significant reduction in periodontitis was observed in the vitamin D supplementation group, indicating a positive relationship between vitamin D supplementation adjuvant to NSPT and improving periodontal symptoms.

Keywords: Vitamin D, Periodontitis, Osteocalcin, Non-Surgical Periodontal Treatment, Plaque Index, Gingival Index, Periodontal Probing Depth, Clinical Attachment loss.

INTRODUCTION:

Periodontitis is a multifaceted inflammatory periodontal disorder triggered by certain microbes that causes the deterioration of the supporting and surrounding dental structures (1). It is a disease that begins in the gingival margin and, if left untreated, causes inflammation to spread to underlying tissue, disrupting bone homeostasis and resulting in loss of teeth (2). The microbial biofilm starting to grow on the surface of the tooth has been identified as the primary cause of periodontal diseases (3). Whilst host response, together with local factors such as plaque formation and calculus, involves determining progression of the disease, genetic factors, environmental exposures, the patient's systemic health, lifestyle behaviors, and multiple social predictors also play an important role (1, 4).

There has been a surge in interest in researching periodontal disease treatment. Moreover, a combination of periodontal therapeutic approaches based on the patient's periodontal status is required to prevent progression of the disease, minimize symptoms, and potentially regain damaged tissues. Oral health education, sub gingival instrumentation to eliminate plaque and calculus, local and systemic drug treatment, and periodontal surgery may all be part of the treatment (5).

Vitamin D (VD), a fat-soluble vitamin, has anti-inflammatory and antibacterial properties (6) and it is also required for bone development and calcification that also appears to include alveolar bone

The nutritious effects of vitamin D levels on periodontitis are of major interest (7-9). A lack of vitamin D and calcium causes an increase in calcium removal from bone, including the alveolar bone, which is likely to result in a negative calcium balance (10). This appears to result in bone loss, which is observed to damage the tooth attachment system. Therefore, reduced vitamin D levels have been linked to elevated periodontal tissue destruction and severe periodontal diseases stages for decades (11, 12).

The research on the effect of serum vitamin D levels on periodontal status is still conflicting (13, 14). Thus, the current study was designed to see if taking vitamin D orally in addition to Non-Surgical Periodontal Treatment (NSPT) improves clinical measures of periodontal health.

MATERIALS AND METHODS:

The current research was a randomized case-control clinical study, which included 50 periodontitis patients. The study was planned and carried out in the Department of Periodontology at a local clinic of Karachi. The investigation included healthy individuals aged between 19-40 years suffering from generalized moderate to advanced periodontitis (stage III) and a minimum of 20 teeth with probing ≥ 5 mm and CAL (Clinical Attachment loss) ≥ 5 mm. Participants who had periodontal treatment in the previous 6 months, medically affected patients (diabetes, hypertension etc.), osteoporosis, osteopenia and patients with a history of disease, disorders, or drugs that may affect mineral metabolism and periodontal health are all excluded.

Clinical parameters used to evaluate periodontitis before and after the treatment included plaque index, gingival index, probing pocket depth, and clinical attachment loss. A single investigating officer completed comprehensive information, including medical history, following the clinical assessment and biochemical evaluation (saliva test). Patients with generalized Chronic Periodontitis (CP) were provisionally enrolled in the research and divided into two groups:

- Group A (control): 25 periodontitis patients were given nonsurgical periodontal therapy (NSPT) alone. At baseline and six weeks after the NSPT, clinical parameters, Osteocalcin levels, and serum vitamin D levels were assessed.
- Group B (test): 25 periodontitis patients were given 600 IU vitamin D supplements daily for 6 weeks as an adjunct to NSPT. Clinical parameters, Osteocalcin levels, and vitamin D serum levels were measured at baseline and after six weeks of NSPT.

Assessment of Osteocalcin levels:

The passive drooling method was employed to collect unstimulated whole saliva. Each tube included about 5 mL of saliva. To prevent debris contamination, a 15-minute centrifugation at 2,600 g at 4°C was performed. To prevent protein degradation, aliquots of saliva samples were prepared and a protease inhibitor was added. The saliva samples were then kept at -80°C for later analysis. Osteocalcin levels in saliva of both groups were analyzed by enzyme-linked immunosorbent assay (ELISA) technique.

Statistical Analysis:

IBM—SPSS version 23.0 was used to analyses all statistical data. p-values less than 0.05 were considered statistically significant. For quantitative data, the mean and standard deviation were calculated, whereas qualitative data were expressed as frequencies and percentages. Paired t test was used to evaluate parameters before and after the intervention. Independent t test was used to evaluate clinical parameters of the two groups (Control and Test).

RESULTS:

The current study included 50 patients with generalized Chronic Periodontitis who were divided into two study groups (Control and Test).

Table 1 presented the demographic data of the study participants. The mean age of the participants in the control and the test group is 32.4 ± 4.5 and 31.6 ± 5.7 respectively. There were 15(60%) males and 10 (40%) female in the control group and 13 (52%) male and 12 (48%) females in the test group.

Table 1: Demographic Data of the Study Participants

Baseline Parameters	Control	Test
Age (Mean \pm SD)	32.4 \pm 4.5	31.6 \pm 5.7
Gender		
Male	15 (60%)	13 (52%)
Female	10 (40%)	12 (48%)
Age is presented as Mean \pm SD Gender presented as frequency and percentage		

Table 2 compares the baseline parameters of the control and test groups. There was no significant difference between the two groups in plaque index, gingival index, probing pocket depth, clinical attachment loss, serum Vitamin D levels, and Osteocalcin levels.

Table 2: Comparison of Parameters at Baseline in the Test and Control Group

Baseline Parameters	Control	Test	p- value
Plaque Index (PI)	1.68 \pm 0.47	1.63 \pm 0.40	0.76
Gingival Index (GI)	1.56 \pm 0.38	1.51 \pm 0.31	0.67
Probing Pocket Depth (PPD)	4.28 \pm 1.07	4.76 \pm 1.02	0.22
Clinical Attachment Loss (CAL)	5.28 \pm 1.22	5.62 \pm 1.13	0.44
Serum Vitamin D (VD)	21.89 \pm 6.97	23.53 \pm 8.7	0.59
Osteocalcin (OCN)	2.54 \pm 0.24	2.41 \pm 0.20	0.13
Parameters were presented as Mean \pm SD Independent t test was applied p-value < 0.05 was considered significant			

The mean plaque index, gingival index, pocket probing depth and clinical attachment loss values at six-week intervals reduced were statistically highest significant ($p \leq 0.001$) in the test group as compared to the control group. Serum Vitamin d levels in test group was significantly higher ($p \leq 0.001$) as compared to control group which showed no significant difference ($p = 0.672$) as mentioned in **Table 3**.

The mean differences in Osteocalcin concentrations before and after intervention revealed significant differences in Osteocalcin concentrations in the test group.

Table 3: Comparison of Parameters at Baseline and After Six in the Test and Control Group

Parameters	Control			Test		
	Before	After 6 weeks	p- value	Before	After 6 weeks	p- value
Plaque Index	1.68 ± 0.47	1.46 ± 0.38	0.012*	1.63 ± 0.40	1.04 ± 0.31	<0.001***
Gingival Index	1.56 ± 0.38	1.39 ± 0.41	0.001**	1.51 ± 0.31	1.01 ± 0.28	<0.001***
Probing Pocket Depth	4.28 ± 1.07	3.11 ± 0.9	0.014*	4.76 ± 1.02	2.46 ± 0.81	<0.001***
Clinical Attachment Loss	5.28 ± 1.22	4.31 ± 0.90	0.005**	5.62 ± 1.13	3.19 ± 0.71	<0.001***
Serum Vitamin D	21.89 ± 6.97	21.86 ± 7.08	0.672	23.53 ± 8.7	27.68 ± 8.2	<0.001***
Osteocalcin	2.54 ± 0.24	2.60 ± 0.21	0.057	2.41 ± 0.20	2.76 ± 0.14	<0.001***

Parameters were presented as Mean ± SD

Paired t test was applied

*p-value < 0.05 was considered significant

**p-value < 0.01 was considered highly significant

***p-value < 0.001 was considered highest significant

Table 4 compares the parameters at six weeks between the control and test groups. There was significant difference between the two groups in plaque index, gingival index, probing pocket depth, clinical attachment loss, serum Vitamin D levels, and Osteocalcin levels.

Table 4: Comparison of Parameters after Six Week in the Test and Control Groups.

Parameters	Control After 6 weeks	Test After 6 weeks	p- value
Plaque Index	1.46 ± 0.38	1.04 ± 0.31	0.003**
Gingival Index	1.39 ± 0.41	1.01 ± 0.28	0.007**
Probing Pocket Depth	3.11 ± 0.9	2.46 ± 0.81	0.032*
Clinical Attachment Loss	4.31 ± 0.90	3.19 ± 0.71	0.001**
Serum Vitamin D	21.86 ± 7.08	27.68± 8.2	0.047*
Osteocalcin	2.60 ±0.21	2.76 ±0.14	0.02*
Parameters were presented as Mean ± SD Independent t test was applied *p-value < 0.05 was considered significant **p-value <0.01 was considered highly significant ***p-value <0.001 was considered highest significant			

DISCUSSION:

Periodontitis is an inflammatory condition of the teeth's surrounding structures caused by a wide range of microbes, resulting in gradual deterioration of the periodontal tissues and loss of alveolar bone as well as increased pocket depth, recession, or both (15).

Vitamin D (VD) deficiency affects almost all demographic, including children, teenagers, adults and elderly (16). Vitamin D supplementation is commonly necessary for maintaining optimal vitamin D status, as sun exposure and dietary habits alone are generally inadequate like most people. The literature review clearly identifies the need for and benefits of supplementation, but there are no regional or national recommendations on the subject (17, 18). Furthermore, there is currently no global consensus on the optimal levels of vitamin D supplementation. In that case, recommendations suggestions vary by country that range from 400 to 2000 IU daily (19). In accordance with the 2011 Institute of Medicine (IOM) document, the recommended daily dose for vitamin D for adults aged 19 to 70 is 600 IU/day for appropriate bone health (20).

Olszewska-et al. carried out an investigation and indicated that vitamin D is used as a supplement in periodontal maintenance therapy, however to the best our knowledge very little research on its application as an adjunctive therapy to NSPT has been conducted in Pakistan (21). As a result, a

case-control study with 50 periodontitis patients was conducted to see if vitamin D could help improve periodontal parameters and Osteocalcin levels when coupled with nonsurgical periodontal therapy.

In our study, a decrease in plaque index was observed after NSPT but a higher decrease was observed in patient with Vitamin d supplementation along with NSPT after 6 weeks of treatment. In contrast to our findings, Weimin Gao et al. reported no dose-dependent decrease in plaque index after three months of vitamin D supplementation treatment (22).

At 6 weeks, the clinical parameters of periodontitis (PI, GI, PPD, and CAL) for both groups were statically significant. This might be due to a reduction in gingival inflammation following nonsurgical periodontal therapy and the removal of local irritants. The significant reduction in gingival index values in the test group at six-week intervals could be attributed to the anti-inflammatory effects of 600 IU vitamin D supplements. This was consistent with the findings of Hiremath et al., who discovered a dose-dependent anti-inflammatory effect of vitamin D supplementation in gingivitis patients (23).

A higher decrease in PPD from start to six weeks in both groups might be related to the potential benefits of NSPT on the soft tissues within the periodontium, which resulted in shrinkage and a decrease in pocket depth. The greater beneficial effect in test group could be the result of additional vitamin D beneficial effect on wound healing. The findings of this study were consistent with the findings of a previous study conducted by Tonguc et al., wherein vitamin D administration benefited therapeutic potentials (24).

The present study mentioned a higher significant decrease in clinical attachment loss in both the groups but it was more evident in participants with additional Vitamin D supplementation. A possible role for vitamin D in periodontitis is also evidenced by the fact that VDR gene polymorphisms are linked to periodontal diseases, alveolar bone loss, clinical attachment loss (25, 26).

Our results supported existing evidence from epidemiological studies on Vitamin D and periodontitis (14, 27) that VD has a periodontal-protective role. In the test group, there was a trend toward greater periodontal healing. As a result, VD supplementation may benefit PD by promoting healing following non-surgical periodontitis treatment.

Betsy et al discovered higher levels of salivary Osteocalcin in periodontal diseases patients (28). The current study compared the levels of Osteocalcin in the saliva of periodontitis patients before and after treatment of two groups and found significant increase in Osteocalcin level in test group. Similarly, Sukumar et al. found that vitamin D supplementation increases Osteocalcin but not the other markers of bone turnover, but this study was done on overweight/obese postmenopausal women with no evidence of type 2 diabetes (29).

Vitamin D may benefit periodontal health by decelerating bone loss at different skeletal sites, including alveolar bone, and attempting to prevent tooth loss. By increasing intestinal calcium and phosphate uptake via Osteocalcin bone mineralization, vitamin D improves the small intestine's

capacity to absorb calcium and phosphate from food and contributes to optimal bone mineralization conditions (30).

CONCLUSION:

Periodontitis is linked to lower serum 25(OH)D levels. Vitamin D supplementation as an adjunct to nonsurgical periodontal treatment was found to be beneficial in improving periodontal symptoms and increasing Osteocalcin based bone mineralization. Future large clinical researches are needed to determine and validate the effect of vitamin D supplementation as well as the biological mechanisms that link vitamin D to the periodontium.

CONFLICT OF INTEREST:

We have no conflicts of interest to disclose.

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