

Influence of Vitamin D & Calcium Supplementation in the Management of Periodontitis

JAYACHANDRAN PERAYIL¹, KEERTHY S MENON², SEEMA KURUP³, ANJU ELIZABETH THOMAS⁴, ANGEL FENOL⁵, RAJESH VYLOPPILLIL⁶, ANURADHA BHASKAR⁷, SAI MEGHA⁸

ABSTRACT

Introduction: It has long been recognized that vitamin D is a hormone and were many studies reporting that patients in periodontal maintenance programs taking vitamin D and calcium supplementation had a trend for better periodontal health compared to patients not taking supplementation.

Aim: To evaluate the effect of vitamin D and calcium supplementation in reducing gingival inflammation, using clinical parameters like gingival index (GI), oral hygiene index-simplified (OHIS), probing pocket depth (PPD), clinical attachment level (CAL) and bone density (BD). Also, to assess whether calcium and vitamin D oral supplementation influences alveolar Bone Density (BD).

Design and Settings: A nonrandomised clinical trial done in Amrita School of dentistry, Kochi, India.

Materials and Methods: Group A taking vitamin D (250IU/day) and calcium (500 mg/day) supplementation, and Group B were not taking oral supplementation. All subjects had at least

one or more teeth with chronic moderate periodontitis. Digital Orthopantomogram images were taken to assess bone density. Data were collected at baseline and three months.

Statistical Analysis used: OHI-S, GI, PPD, CAL, and Bone Densities (BD) were calculated per group. Karl Pearson Coefficient of correlation was used to test correlation of bone density with GI and OHI-S. Intergroup comparison of parameters were done using Independent two Sample t-test. Intragroup comparison of parameters at recall interval was done using Paired sample t-test. The results were considered statistically significant when p-value was <0.05.

Results: Both Groups showed significant change in the periodontal parameters and bone density after three months and intragroup comparison showed highly significant results for vitamin D group in relation to GI, OHI S and bone density.

Conclusion: Calcium and vitamin D supplementation has got a positive effect on periodontal health and it can be used as an adjunct to non surgical periodontal therapy.

Keywords: Calcium carbonate, Cholecalciferol, Recolonization

INTRODUCTION

Periodontitis is an inflammatory disease of the supporting tissues of the teeth caused by group of specific microorganisms, resulting in progressive destruction of periodontal ligament and alveolar bone loss with increased pocket depth, recession, or both [1,2].

Vitamin D is secosteroid hormone thought to be potentially influencing risk of periodontal disease through three mechanisms: maintenance of oral bone health, anti inflammatory activity and anti microbial activity. It is essential for consumption of calcium from the gut and re-absorption of calcium from kidneys and bone formation in order to maintain adequate plasma calcium concentrations for calcium homeostasis, bone mineralisation [3,4] and immunity [5]. There is biologic surmise that multiple actions of vitamin D are potentially appealing for the management of chronic periodontitis, whose pathogenesis is based on bacterial driven inflammation. It is speculated that status of vitamin D could modify the risk of periodontitis [6] by preventing alveolar bone loss [7] or by mediation of host's immune response to infection. Thus, there is evidence pointing to the potential role of calcium and vitamin D intake on dental health; however, there are controversies regarding the role of calcium and vitamin D supplementation in chronic periodontitis and its management. Definition regarding the use of optimum levels of vitamin D for maintenance of bone health has been a matter of debate [8].

Vitamin D synthesis in body is influenced by various factors like environmental (pollution, location), local factors (duration and time of exposure in sunlight, diet, job) and genetic factors. Even though a majority of Indian population inhabit in places receiving ample sunlight all year long, vitamin D deficiency is quite common in age

groups even now in India [9,10]. The Indian Council of Medical Research (ICMR) recommends daily intake of 600 mg of calcium in adults and 800 mg of calcium in post menopausal age group. Yet the typical Indian diet fails [11,12] to ensure even 10% of daily vitamin D requirement and continues to recommend 400 IU per day of oral vitamin D [9,13-15]. Hence, the present study was designed to find any influence of calcium and vitamin D supplementation in periodontitis treatment outcome in otherwise healthy subjects whose serum calcium and vitamin D levels are in normal range. Primary objective of the study was to evaluate the effect of vitamin D and calcium supplementation in management of periodontitis. Secondary objective was to assess whether calcium and vitamin D oral supplementation influences alveolar bone density.

MATERIALS AND METHODS

The study was conducted for a period of one year in the Department of Periodontics, Amrita School of Dentistry, Kochi, India from November 2012 and De-cember 2013.

The ideal sample size to ensure adequate power for this study was calculated based on the results from the study conducted by Miley et al., [16].

Inclusion Criteria

1. Age group ≥ 35 and ≤ 55 years, ≥ 20 number of natural teeth.
2. One or more teeth with chronic moderate periodontitis, attachment loss of 3-4mm.
3. Bone loss in the mandibular molar (except third molars) with mandibular furcation area with at least 1x1mm square area were selected in OPG as standard reference points for density analysis.

Exclusion criteria

1. Periodontal therapy within the past 6 months.
2. History of any systemic diseases.
3. Subjects with behavioural eating disorders.
4. History of antibiotic therapy in last six months.
5. Continuous exposure to direct sunlight for more than three hours a day.
6. Intake of any other nutrient supplements.

Subjects filled out a personalised questionnaire about food, job and duration of direct exposure to sunlight per day. So if the patient is taking any other nutrient supplement were excluded from the study. No special instructions were given about diet. A written informed consent was obtained from subjects.

Study design

In this non randomised clinical trial, 82 subjects were assessed, 40 were allocated into Group A, subjects who received full mouth oral prophylaxis, subgingival scaling, root planing and curettage along with calcium and vitamin D sup-plementation (Shelcal-D 500 mg calcium+250 IU vitamin D once daily) for three months and 42 in Group B, subjects who received full mouth oral prophylaxis, subgingival scaling, root planing and curettage. Four subjects from Group A and one subject from Group B were lost during follow up. Finally, there were 36 subjects in Group A and 41 subjects in Group B. SRP and curettage was done to reduce inflammation and standardize both groups.

We decided to give a minimum dosage of calcium and vitamin D supplementation for a shorter time period as per physician's consultation. Recent study by Hiremath [17] et al., had specified in his study that a lower dosage of vitamin D will take atleast three months to be present in the serum. According to Marwaha [18] et al., and Malhotra [19] et al., Vitamin D requirement of 60,000-120,000 IU per month to achieve Vitamin D level > 30 ng/ml, level at which calcium absorption from the gut is maximum. Serum calcium and vitamin D recorded just to make sure that it was within normal limits. Three ml blood was drawn from participants and serum vitamin D level checked with direct Elisa kit (Immunotek; Bensheim, Germany) and serum calcium using Calcium detection kit (Abcam) in Amrita laboratory, AIMS, Kochi, India.

Periodontal examination at baseline involved recording clinical parameters like Oral Hygiene Index – Simplified (OHI-S) [20], Gingival Index (GI) [21], Probing Pocket Depth (PPD) and Clinical Attachment Level (CAL). Probing Pocket Depth and Clinical Attachment Level were measured using University of Michigan "O" probe with Williams' markings at six sites per tooth (mesio-buccal/labial, mid-buccal/labial, disto-buccal/labial, mesio-lingual/palatal, mid-lingual/palatal, disto-lingual/palatal) at all teeth, excluding third molars, using a customized acrylic stent.

Subjects in the Group A were given special instructions to have more than two litres of water daily since they were taking oral supplement with calcium and vitamin D to prevent possible side effects like precipitation of calcium in the urine, gall bladder or kidney and manifested as colic pain. Bone density was recorded using software named SIDEXIS [22] in the digital OPG machine for both groups at baseline as well as at the end of three months.

STATISTICAL ANALYSIS

OHI-S, GI, PPD, CAL, and Bone Densities (BD) were calculated per group. Karl Pearson Coefficient of correlation was used to test correlation of bone density with GI and OHI -S. Intergroup comparison of parameters were done using Independent two Sample t-test. Intragroup comparison of parameters was done using Paired sample t-test. The results were considered statistically significant when p-value was <0.05.

RESULTS

Baseline Comparison given in [Table/Fig-1].

Variable	Group A (36)	Group B (41)	p-value
GI Baseline	2.08 ± 0.37	2.05 ± 0.44	0.707
OHI-S Baseline	4.01±0.20	3.74±0.26	0.001*
PPD(mm) Baseline	6.26 ±0.45	5.93 ± 0.39	0.001*
CAL(mm) Baseline	6.29 ± 0.74	5.94 ± 0.39	0.016*
BD(%) Baseline	40.75± 4.08	41.37± 2.98	0.458

[Table/Fig-1]: Intergroup comparison of parameters at baseline
*indicates significant p-value

Post intervention comparison of parameters

The intragroup comparison of clinical parameters in Group A [Table/Fig-2] and group B [Table/Fig-3] showed that there was statistically significant difference after three months.

[Table/Fig-4] represents the intergroup comparison of clinical parameters at the end of three months. There was statistically significant difference in OHI-S (p<0.05), GI (p<0.05), and BD (p<0.05) but in case of PPD (p<0.05) and CAL (p>0.05) there was no statistically significant difference.

Correlation of bone density with OHI-S and GI after three months in Group A [Table/Fig-5] showed negative correlation. The results showed that there is slight increase in Serum Calcium and vitamin D in group A after three months [Table/Fig-6].

Variable	Group A (36)		p-value
	Baseline	3 months	
GI	2.08 ± 0.37	0.33 ± 0.39	0.001*
OHI-S	4.01±0.20	0.79 ±0.37	0.001*
PPD (mm)	6.26 ±0.45	4.25 ± 0.31	0.001*
CAL (mm)	6.29 ± 0.74	4.45 ± 0.64	0.001*
BD (%)	40.75± 4.08	49.33 ± 4.72	0.001*

[Table/Fig-2]: Intragroup comparison of parameters of Group A
*indicates significant p-value

Variable	Group B(41)		p-value
	Baseline	3 months	
GI	2.05 ± 0.44	1.09± 0.15	0.001*
OHI-S	3.74±0.26	2.25 ±0.28	0.001*
PPD (mm)	5.93 ± 0.39	4.39 ± 0.35	0.001*
CAL (mm)	5.94 ± 0.39	4.52 ± 0.37	0.001*
BD (%)	41.37± 2.98	45.63 ±0.267	0.001*

[Table/Fig-3]: Intragroup comparison of parameters of Group B
*indicates significant p-value

Variable	Group A (36)	GroupB (41)	p-value
GI 3 months	0.33 ± 0.39	1.09± 0.15	0.001*
OHI-S 3 months	0.79 ±0.37	2.25 ±0.28	0.001*
PPD(mm)3months	4.25 ± 0.31	4.39 ± 0.35	0.057
CAL(mm)3months	4.45 ± 0.64	4.52 ± 0.37	0.558
BD(%)3 months	49.33 ± 4.72	45.63 ±0.267	0.001*

[Table/Fig-4]: Intergroup comparison of parameters after 3 months
*indicates significant p-value

Variable n=36	Group A (BD) (n=77)
GI Pearson Correlation	-0.390
p-value	0.001*
OHI-S Pearson Correlation	-0.358
p value	0.001*

[Table/Fig-5]: Correlation of bone density at 3 months with GI and OHI-S at 3 months
*indicates significant p-value

Groups	Serum Calcium Baseline Mean \pm SD (mg/dl)	Serum Calcium 3months Mean \pm SD (mg/dl)	p-value	Serum Vitamin D Baseline Mean \pm SD (ng/ml)	Serum Vitamin D Baseline Mean \pm SD (ng/ml)	p-value
A	9.21 \pm 0.17	9.86 \pm 0.19	0.001	25.97 \pm 1.31	36.01 \pm 1.23	0.001
B	9.28 \pm 0.16	9.35 \pm 0.15	0.001	25.53 \pm 0.24	25.62 \pm 0.22	0.001
p-value	0.043	0.001		0.056	0.001	

[Table/Fig-6]: Mean serum calcium and vitamin D levels at baseline and after 3 months

DISCUSSION

In the present study, the subjects in Group A received oral supplementation of calcium and vitamin D (a combined dose of 500mg calcium and 250 IU Vitamin D) once daily for three months. All the clinical parameters assessed in both groups showed that both interventions were effective in restoring periodontal health. Our results also showed as the bone density increased; gingival index and OHI-S were decreasing. All the clinical parameters were significant, which is in accordance to the results of Miley et al., [16] and Garcia et al., [23]. But the difference is that they had been giving higher doses of vitamin D supplementation for longer time period.

The study of Hiremath et al., [17] evaluated the anti-inflammatory effect of vitamin D on gingivitis at various doses which revealed that there was a dose-dependent anti-inflammatory effect of vitamin D on gingivitis and concluded that vitamin D was a safe and effective anti-inflammatory agent in doses ranging from 500 IU to 2000 IU. But in their study, subjects were found to be having only gingivitis; hence their analysis did not describe any effects of vitamin D on clinical parameters and effects on periodontitis. But in this study we have included subjects with periodontitis and analysed effect of calcium and vitamin D on clinical parameters and bone density. The increase in bone density may be due to the slight increase in serum calcium and vitamin D levels. A slight positive effect is seen on group A in our study.

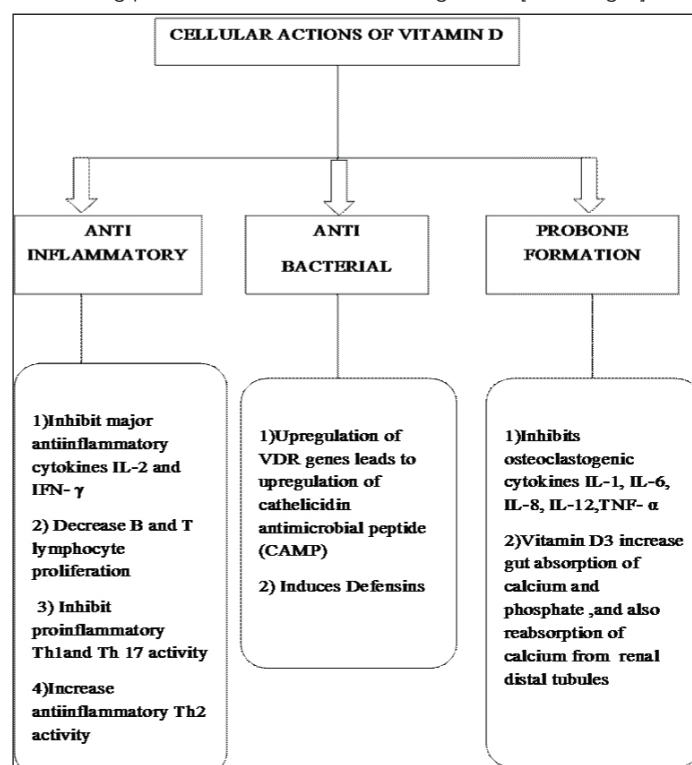
Krall et al., [24] reported that vitamin D may have beneficial effects on periodontal disease and tooth loss, possibly because of its anti-inflammatory effects. However, other studies [11] have shown that the anti-inflammatory effect of vitamin D is evident only at doses of 500 IU and above. The present study shows that Group A, demonstrated an anti-inflammatory effect at the third month.

Our results show that even though SRP resulted in significant reduction in PPD and CAL, leading to an improvement in their periodontal status, a complete elimination of PPD and the resultant gain in CAL could not be obtained. Various factors are responsible for this as periodontitis is a multifactorial disease caused by tissue invading organisms, which can recolonize or reinfect [25] not only from periodontal pockets but also from other oropharyngeal habitats (mucous membranes, tongue, tonsils and saliva). Other studies by Fentoglu [26] et al., also reported a significant reduction in levels of serum TNF- α , IL1- β , and IL-6 in subjects with periodontitis at 3 months follow up after completion of non surgical periodontal treatment that included scaling and root planing. However, non surgical periodontal therapy cannot bring about complete elimination of all subgingival bacteria since re-colonisation [27] occurs over a period of time.

The slight improvement in clinical parameters and bone density in Group A may be because of the molecule LL-37 present in vitamin D has broad spectrum activity against Gram positive and Gram negative microorganisms, including those associated with periodontal disease [28]. Role of these peptides in the natural defence against colonisation by periodontal pathogens such as *A. actinomycetemcomitans* is proved in many studies [29]. Since bacteria do not develop resistance to antimicrobial peptides such

as LL-37, it is postulated that vitamin D supplementation prevents anti microbial resistance as well as recolonization.

Recent studies reveal that there are three main mechanisms through which vitamin D and calcium supplementation are effective in reducing periodontitis which has been given in [Table/Fig-7].



[Table/Fig-7]: Adjunctive effects of calcium and vitamin D supplementation in periodontitis [30-35]

All these mechanisms together must have contributed to better periodontal status in group A subjects.

In short, as periodontal disease is associated with colonization of pathogenic bacteria in gingival epithelium, resulting in gingival inflammation, it is speculated that vitamin D may have a profound effect in prevention of this colonization with direct antimicrobial activity, as well as enhancement of the natural innate immune response without any antibiotic resistance. These results of the study strongly recommend that calcium and vitamin D can be given as an adjunct to SRP for better periodontal outcomes.

LIMITATIONS

Limitations of the study were we didn't include medically compromised subjects with periodontitis and time period was only three months.

CONCLUSION

According to our study, we got superior results on periodontal parameters by oral supplementation of low dose of calcium and vitamin D. No side effects like colic pain were reported by any of the subjects in the time period of three months. Gingival inflammation reduced as the bone density increased. So, it can be concluded that vitamin D and calcium supplementation has got a slight positive effect in the periodontal treatment and it can be used as an adjunct to SRP for a better treatment outcome.

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PARTICULARS OF CONTRIBUTORS:

1. Professor and HOD, Department of Periodontics, Amrita School of Dentistry, Ponekkara, Kochi, India.
2. Post Graduate Trainee, Department of Periodontics, Amrita School of Dentistry, Ponekkara, Kochi, India.
3. Professor and HOD, Department of Oral Medicine and Radiology, Amrita School of Dentistry, Ponekkara, Kochi, India.
4. Post Graduate Trainee, Department of Oral Medicine and Radiology, Amrita School of Dentistry, Ponekkara, Kochi, India.
5. Professor, Department of Periodontics, Amrita School of Dentistry, Ponekkara, Kochi, India.
6. Professor, Department of Periodontics, Amrita School of Dentistry, Ponekkara, Kochi, India.
7. Reader, Department of Periodontics, Amrita School of Dentistry, Ponekkara, Kochi, India.
8. Assistant Professor, Department of Periodontics, Amrita School of Dentistry, Ponekkara, Kochi, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Jayachandran Perayil,
Professor and HOD, Department of Periodontics, Amrita School of Dentistry, Ponekkara, Kochi-682041, India.
E-mail : jayachandranp@aims.amrita.edu

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