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RELATIONSHIP BETWEEN SERUM CALCIUM LEVELS AND PERIODONTAL DISEASE: A CLINICO-BIOCHEMICAL STUDY

Dental Science

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ABSTRACT

Aim: The aim of this study is to observe co-relation between serum calcium levels and Periodontal diseases.

Material & Method: The present study was conducted to determine the serum calcium levels, hence knowing its effect on the periodontium in College Of Dental Sciences And Research Centre, Ahmedabad. Thirty patients, both female and male were included in the study. The study was conducted among 15 periodontitis patients and 15 control patients with healthy periodontium. Blood samples will be collected and Serum calcium levels will be estimated in patients with chronic periodontitis and healthy periodontium.

Results: The mean serum calcium level observed significantly higher in patients with periodontitis compared to patients with healthy periodontium.

Conclusion: A decreased intake of calcium has adverse effects on the oral cavity leading to periodontitis. Hence, Serum calcium may be considered a risk factor for periodontal disease. Further studies will be needed to better define the role of calcium in periodontal disease and to determine the extent to which calcium supplementation will modulate periodontal disease and tooth loss.

KEYWORDS

Periodontitis, Serum Calcium, Bone loss, Risk factor.

INTRODUCTION

Nutrition plays an important role in overall health, including oral health, eating well and maintaining a healthy diet can help reduce the risk of developing problems in your oral cavity, including periodontal disease. Most people know that dairy products can help to build strong bones and can also help in reducing periodontal diseases. Animal as well as human status of calcium intake, bone mineral density and tooth loss provide rationale for hypothesizing that low dietary intake of calcium is a risk factor for periodontal disease.[1]

Calcium is the most abundant mineral in humans. Virtually 99% of the total calcium in the human body exists in the bones and teeth and provides a structural function, while the remaining 1% found in tissues and fluids is crucial for the maintenance of cell metabolism, nerve transmission and muscle contraction.[2]

Periodontitis is defined as the inflammatory disease of the supporting tissues of the teeth caused by specific microorganisms or groups of specific microorganisms,

resulting in progressive destruction of the periodontal ligament and alveolar bone with pocket formation, recession or both.[3]

Chronic periodontitis may be sequel of chronic gingivitis, due to accumulation of plaque and calculus. The gingiva detaches from the tooth, the periodontal membrane and alveolar bone are damaged, and pocket formation occurs which eventually leads to loss of tooth .[4] It is stated that chronically low intakes of calcium may lead to a negative calcium balance, thus causing a secondary increase in calcium removal from the bone, including the alveolar bone. Such bone loss may contribute to weakening the tooth attachment apparatus.[5]

Researchers have been exploring the role played by calcium in the aetiology and/or progression of periodontal diseases for well over four decades. Several animal and human studies point to an association between dietary calcium and periodontitis. For instance, **Oliver W (1969)[6], Abe et al. (1989)[7] and Amano H (1989)[8]** have observed a relationship between calcium-deficient diet and the progression of periodontitis in rats whereas **Osborn et al. (1977)[9], Vogel et al. (1979)[10], Nishida et al. (2000)[11] and Krall et al. (2001)[12]** have obtained similar findings in human studies. Accordingly, it has been hypothesized that low dietary intake of calcium may contribute to progression of periodontitis.[6-11]

Therefore, the current study was carried out to know the effect of calcium on oral cavity especially on the periodontium.

MATERIALS AND METHODS

Study population

The present study was conducted to determine the serum calcium levels, hence knowing its effect on the periodontium in College Of Dental Sciences And Research Centre, Ahmedabad. The study was approved by Ethical Committee of College of Dental Sciences and Research Centre before the commencement of the study. The study was conducted among thirty patients, both female and male were included .The patients were informed the procedure of the study, and an informed consent was taken.

They were divided into two groups consisting of 15 patients each.

Group A: Patients with healthy gingiva with no change in color, no signs of redness, edema and no bleeding on probing.

Group B: Patients with chronic generalized periodontitis with marked redness, edema and tendency of spontaneous bleeding on probing, at least 5 teeth having probing depth (PD) ≥ 6 mm.

Inclusion Criteria

Group A (healthy patients):

1. Subject who maintains a healthy oral environment

Group B (periodontitis patients):

1. Subjects with chronic generalized periodontitis.
2. Subjects whose pocket depth was found to be more than 6.
3. Age group 35-60 years

Exclusion Criteria:

1. Periodontal surgery within the last year.
2. Scaling and root planing as part of initial periodontal therapy within the past six months.
3. History of diabetes, History of disease, conditions, or use of medications that might affect bone and mineral metabolism and periodontal health.
4. Treatment with fluoride, oestrogen and bisphosphonates
5. Behavioural eating disorder.

6. Current treatment with antibiotics.

Armamentarium

A. For Periodontal examination (Figure 1)

1. Mouth mirror
2. UNC-15 probe
3. Tweezers
4. Cotton
5. Kidney tray
6. Gloves
7. Mask
8. Cheek retractor

B. For Blood Collection (Figure 2,4)

1. Cotton
2. Disposable syringes
3. Serum and blood collection vials
4. Centrifugation machine

C. For biochemical evaluation

1. Erba Liquixx Calcium Kit (ARSENAZO III Method, End Point) (Figure 6)
2. Biochemical analyzer (Figure 7)

Methodology:

Dental examination was done in the Department of Periodontology, College Of Dental Sciences And Research Centre, Ahmedabad under natural light source. Probing depth (PD) were measured using William's periodontal probe to assess the periodontal status. PD was measured as the distance from the gingival margin to the bottom of the probed pocket. Probing depths were recorded at six sites per tooth, rounded up to the nearest millimetre. The subjects were not on any kind of prescribed medication or dietary restrictions.

Two millilitres of venous blood was collected under aseptic conditions and then transferred into sterile test tube with anticoagulant in it to prevent coagulation of blood (Figure 3,5). The samples were then transferred to the laboratory immediately for determination of calcium levels using Arsenazo III method, end point.

Calcium Estimation

Biochemical assays of blood samples were carried out to quantify the calcium levels. The kit consisted of Arsenazo III reagent and calcium standard.

Principle: Arsenazo III is chemically stable and has a very high affinity for calcium in a neutral pH range. In this assay system, Arsenazo III forms a blue Arsenazo III – calcium complex with an absorbance maximum at 650 nm. The concentration of calcium is proportional to the absorbance of the blue coloured Arsenazo III – calcium complex. Arsenazo III has a high infinity (k0 =1×10-7) for calcium ions and shows no interference from other cations normally present in serum, plasma or urine.

Test parameters:
Wavelength: 650 nm
Temperature: 37°C
Sensitivity: the lower limit of detection is 0.04 mg/dl.

Reagents used:

Phosphate buffer, pH7.5
8- hydroxyquinoline-5-sulfonic acid
Arsenazo III
Detergents



Figure 1: Armamentarium



Figure 2: Blood Collection Equipment



Figure 3: Blood Collection



Figure 4: Centrifugation Machine

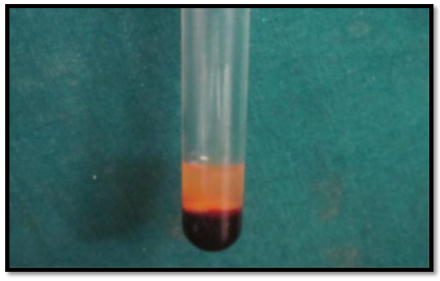


Figure 5: Serum sample



Figure 6: Serum calcium kit



Figure 7: Biochemical Analyser

STATISTICAL METHODOLOGY AND RESULTS

Descriptive statistical analysis was carried out in the present study and the data obtained was suitably tabulated using SPSS version 16.0. All the values were expressed in the form of mean, standard deviation. The parameters were compared between Group A and Group B. The results were obtained using unpaired student 't' test (Table 2, Graph 1). Karl-Pearson's correlation coefficient test was used to measure the correlation between clinical parameter i.e. probing depth and serum calcium levels in Group A and Group B (Table 3, Graph 2).

Demographic data is tabulated in Table 1.
Group A: Patients with healthy gingiva
Group B: Patients with periodontitis
p value < 0.05 is significant (S)
p value < 0.01 is highly significant (HS)

Table 1: Demographic Study

Study design	Total no.of cases	Sex		Age range (in years)	Total no. of groups	
Cross sectional Study	30	Male	Female	35-60 yeras	Group A	Group B
		10	20		15	15

Table 2: Mean values of clinical parameter and serum calcium level in Group A and Group B

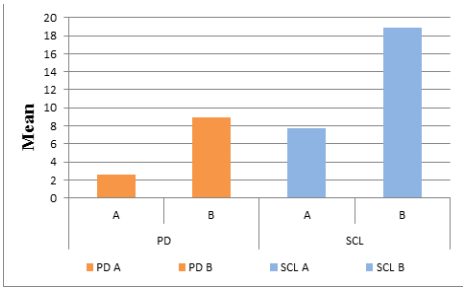
	GROUP	N	Mean	p value
PD	A	15	2.65±0.481	S
	B	15	7.77±1.541	S
SCL	A	15	8.960±0.5642	S
	B	15	18.907±3.6591	S

PD - Probing depth, SCL- Serum calcium level

Mean values for serum calcium level in patients with periodontal disease (18.907±3.6591) were increased compared to control subjects (8.960±0.5642).

A significant difference was observed between Group A and Group B for all the parameters (p value < 0.05).

Graph 1: Mean values of clinical parameter and serum calcium levels in Group A and Group B



PD - Probing depth, SCL- Serum calcium level

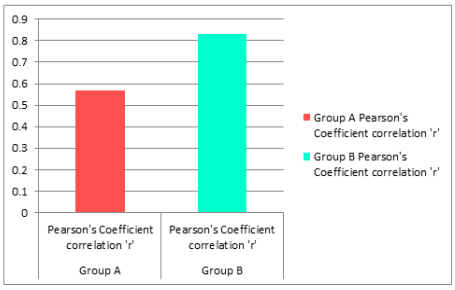
Table 3: Pearsons's correlation coefficient among serum calcium levels clinical parameter in Group A and Group B.

	Group A		Group B	
	Pearson's Coefficient correlation 'r'	p value	Pearson's Coefficient correlation 'r'	p value
PD	0.568	HS	0.833	HS

PD - Probing depth
Correlation is highly significant (p value < 0.01)

The variation in serum calcium level values was correlated with variation changes in the clinical parameter i.e. pocket depth, which was determined using Karl-Pearson's coefficient correlation test. A positive correlation between the clinical parameter and serum calcium levels were observed in Group A and Group B.

Graph 2: Correlation among clinical parameter and the serum calcium levels in Group A and Group B.



When correlation between PD and serum calcium level was evaluated then a statistically highly significant correlation was found in Group B(r = 0.833, p > 0.01).

DISCUSSION:

Periodontitis is an inflammatory condition due to bacterial challenge, which ends up to alveolar bone loss. Due to bone loss, there can also be mobility of teeth.[3]

The present study was an attempt to estimate and co-relate serum calcium levels in healthy subjects and patients with periodontitis. In the current study, it has been elucidated that an increased level of serum calcium levels were observed in patients with periodontitis and hence that indicate that there was a direct relationship between the total serum calcium concentration and periodontal disease.

The serum calcium level is generally maintained within a narrow range of 8.5-10.2 mg/dl (2.25–2.75 mol/l). However, the total serum calcium was statistically significantly higher in periodontitis group when compared to healthy group.

It has been evident that, low dietary intake of calcium results in bone loss to meet the needs of the body for normal functional activities. Bone contains 99% of the body's calcium ions and therefore is the major source for calcium release when the calcium blood levels decrease; this is monitored by the parathyroid gland.

A decrease in the blood calcium is mediated by receptors on the chief cells of parathyroid glands, which then release parathyroid hormone (PTH). PTH stimulates osteoblasts to release interleukin-1 and interleukin -6, which inturn stimulate monocytes to migrate into the bone area. Than, Leukemia-inhibiting factor (LIF), secreted by osteoblasts, coalesces monocytes into multinucleated osteoclasts, which then resorb bone , releasing calcium ions from hydroxyapatite into blood and this release normalizes the blood level of the calcium. A feedback mechanism of normal blood levels of calcium turns off the secretion of PTH.[13]

In the present study, serum calcium levels increased with the increase in the probing depth (PD) in all the patients with periodontitis. The mean probing depth in Group A was 2.65±0.481 and in Group B was 7.77±1.541(Table 2, Graph 1). Statistically highly significant correlation was found between probing depth and serum calcium level in Group B (r = 0.833, p > 0.01) (Table 3, Graph 2).

Serum calcium levels were also compared and evaluated in the patients with periodontitis and patients with healthy gingiva. The mean serum calcium levels in Group A recorded was 8.960±0.5642and in Group B was 18.907±3.6591. A significantly elevated serum calcium level was found in Group B as compared to Group A (p < 0.05) (Table 2). Thus it was concluded that the patients with periodontitis demonstrated a mean serum calcium levels higher than the patients with healthy gingiva. This indicates that there is a significant association between periodontitis and serum calcium concentrations.

The obtained results were in accordance to the studies conducted previously by Nishida et al. (2000)[11] and Pushparani et al. (2014).[14] In periodontitis affected individuals, due to alveolar bone destruction there can be increased serum calcium level.

Nishida et al (2000)[11] colleagues studied the role of dietary calcium intake as a contributing risk factor for periodontal disease, measured by attachment loss. Their subjects were in The Third National Health

and Nutrition Survey.

Several studies relate the lower level of calcium intake with increased level of periodontal disease. Wical and Brussel (1979)[15] found that calcium supplementation reduced the rate of residual ridge resorption in the first year after extraction of tooth. Kribbs et al (1990)[16], in his study have reported that mandibular bone mass was not related to age but was related to skeletal bone mass.

CONCLUSION

Periodontal diseases are inflammatory in nature, such that it causes changes in the mineral content in the blood. In the present study, an increased level of serum calcium was observed. In summary, our study demonstrates that lower dietary calcium intake and total serum calcium levels have a statistically significant association with more severe levels of periodontal disease. It is therefore, suggested that monitoring for change in serum composition might be a useful tool to establish periodontal health status. Further studies may be required to determine calcium homeostasis with its regulatory mechanism in periodontitis patients.

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