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Salivary calcium concentration in patients with high incidence of calculus formation

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ABSTRACT

Salivary calcium level was determined in this study in individuals with good oral hygiene who have no repetitive history of calculus accumulation, and in individuals with a history of repetitive calculus formation whether subgingival or supragingival in spite of their attempts in controlling their oral hygiene. Salivary calcium concentration was significantly higher in the second group. Moreover, salivary calcium concentration in this study varied according to age. It is advisable to use alkaline mouthwashes and intensive good oral hygiene to control their calculus formation.

Key Words: Salivary calcium concentration, subgingival calculus, supragingival calculus, oral hygiene.

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INTRODUCTION

Salivary calcium is related to plasma levels and is about 3 mmol/L under resting condition. Like plasma, the major fraction of salivary calcium is diffusable and ionic while the rest is in a bound form, either with protein or as colloidal calcium phosphate. Salivary calcium and phosphorus have been implicated in the deposition of tartar over teeth and formation of salivary calculus. High level of salivary calcium is apparently responsible for the resistance to dental decay.[1]

The human body contains more calcium than any of the other essential minerals, as much as 1200 g in a 70 Kg adult. Most skeletal calcium is deposited as a form of hydroxyapatite $Ca_{10}(PO_4)_6(OH)_2$.[2] Calcium concentration in saliva is low; the normal concentration of calcium in unstimulated whole mixed saliva is 4–6 mg/dL.[3,4] In alkaline pH, calcium plays an important role in remineralization of enamel surface via formation of hydroxyapatite crystals, while in acidic pH salivary calcium plays a role in preventing dissolution of enamel.[5,6] Dental calculus represents mineralized bacterial plaque. Recent and old calculus consist of four different crystals of calcium phosphate:

1. $CaH(PO_4)\times 2H_2O$= Brushite (B).
2. $Ca_4H(PO_4)_3\times 2H_2O$= Octa calcium phosphate (OCP).
3. $Ca_5(PO_4)_3\times OH$= Hydroxyapatite (HA).
4. B–$Ca_3(PO_4)_2$= Whitlockite (W).[7]

The mineral content is 37%, but ranges from 16 to 51% with some layers yielding a maximal density of minerals of up to 80%.[8] In the presence of relatively low plaque pH and concomitant high Ca/P ratio in saliva, B is formed which may lateron develop into HA and W. When supragingival plaque mineralizes, OCP forms and is gradually changed into HA. In the presence of alkaline pH and anaerobic condition and concomitant presence of magnesium or zinc and CO_3, a large amount of W are formed, which are stable form of mineralization.[9]

The aim of this study was focused on the significant effect of elevated salivary calcium concentration on the repetitive accumulation of calculus in some individuals rather than others.

SUBJECTS AND METHODS

Patients Selection

Forty two individuals were participated in this study; their age ranged between 19 to 60 years. All individuals were medically fit, non smoker, not receiving any medication or vitamins or minerals supplements. Oral examination was performed by a dentist for recording the presence or absence of subgingival or supragingival calculus. According to this criterion, indiv-iduals were divided mainly into healthy; where no clinical evidence of calculus wi-th healthy gingival appearance, or patients; where the presence of sub or supragingival calculus was recorded.

Collection of Saliva Samples

Unstimulated saliva was collected fr-om all individuals in plastic tubes over a period of not more than 7 minutes. Prior to collection of saliva, patients were instructed to wash their mouth with unionized water to remove any food or debris in their mouths. Saliva was centrifuged at 4000 g using a bench centrifuge. The supernatant was then collected and stored at –10 ºC.

Determination of Salivary Calcium

Determination of calcium was performed by Biomerioux (France) calcium kit using spectrophotometer end point method and reading results by spectrophotometer (CECIL 1021, England) at 650 nm wavelength. The principle depends on the reaction of Arsenazo III that react with calcium in a slight acidic medium to form blue–purple complex. The intensity of the colour is proportional to calcium concentration.[10] The optical density (OD) was measured at 650 nm against the blank. Calcu lation was done according to the following equation:

$$\frac{\text{OD of Sample}}{\text{OD of the Standard}} \times \text{standard concentration} = \text{concentration of calcium in mmol/L}$$

The data were statistically analyzed using Student's t–test and one way analysis of variance (ANOVA).

RESULTS

Thirty healthy individuals were divided into three groups according to their ages (Table 1). Group I: Twelve healthy individuals with mean age of 21.7 ± 1.53 years; group II: Eight healthy individuals with mean age of 31 ± 5.13 years; and group III: Ten healthy individuals with mean age of 49 ± 7.5 years.

Table (1): Age distribution in healthy individuals

Group	Age (Years)	Mean ± SD	Number
I	19–24	21.17 ± 1.53	12
II	25–40	31.00 ± 5.13	8
III	41–60	49.00 ± 7.50	10

SD: Standard deviation.

Salivary calcium level was recorded as shown in Table (2); where higher salivary calcium concentration was observed in group I and it was significantly higher than those of groups II and III, by using ANO-VA.

Table (2): Salivary calcium concentration in different groups (healthy individuals)

Group	Salivary Calcium Concentration (mg/dL) Mean ± SD
I	$8.26 \pm 1.57^{*\,++}$
II	$6.59 \pm 1.29^{*}$
III	$6.89 \pm 1.78^{++}$

SD: Standard deviation.
* p value < 0.05 (significant)
$^{++}$ p value < 0.05 (significant)

Twenty two patients were recorded in this study and were classified as group IV as in Table (3). Salivary calcium concentration was significantly higher than those of groups I, II and III.

There was no significant difference between male and female salivary calcium level ($p > 0.05$).

Table (3): Salivary calcium concentration and patient age (patients group)

Patient	Age (Years) Mean ± SD	Salivary Calcium Concentration (mg/dL) Mean ± SD	Number
Group IV	34.00 ± 11.9	12.28 ± 3.94	22

SD: Standard deviation.

DISCUSSION

Salivary calcium plays major role in the formation of supra or subgingival calculus in the presence of unmineralized dental plaque.[5] Some dental patients were always complained from development of calculus yet they tend to control their oral hygiene. In this study salivary calcium concentration was noticed to be significantly high in patient who develops dental calculus when compared to the control group. This finding reflects the importance of instructing those patients for maintaining their salivary pH alkaline to permit excess calcium ion to be used in remineralization of teeth rather than formation of calcium and maintaining good oral hygiene. This could be established by the use of different commercially available mouth washes.[6]

The level of calcium ion in healthy individuals was varied in this study according to age of individuals (Tables 1 and 2).

Salivary calcium concentration was significantly high in younger individuals where period of development and maturation of skeleton and teeth and it tends to decline with advancing age where the time of osteoporosis, although the data obtained in group II and III were within normal values.[3, 4] In this study, sex had no influence on salivary calcium concentration.

CONCLUSION

Excess calcium concentration was observed in patients who have tendency to develop supra or subgingival calculus. Instruction for good oral hygiene and using alkaline mouthwashes is important in those individuals to minimize this problem.

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