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Themations	CORRELATION OF PULPAL CALCIFICATIONS WITH SALIVARY PH AND DENTAL CARIES – A CROSS-SECTIONAL STUDY					
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Background: The pH plays a vital role in demineralization and remineralization of the calcified tissues.

salivary pH.

ABSTRACT

Based on this concept, the study focused on correlating the presence of calcifications of the pulp with

Aim: To evaluate the correlation of salivary pH with the presence of pulpal calcifications.

Materials and methods: A sample size of 100 patients were included in the study. Patients of age group 18 - 35 years were advised for orthopantomography (OPG) and were considered for saliva collection. The unstimulated saliva was tested for pH and OPG was analyzed for presence of any pulpal calcification and dental caries. Based on the presence or absence of pulpal calcifications, the samples were grouped into the following-Group 1: samples with pulpal calcifications and Group 2: samples without pulpal calcifications. Statistical analysis was performed using Paired Student's t-Test and SPSS Version 17.0 software. Results: It was observed that Group 1 which included teeth with pulpal calcifications showed a mean salivary pH value of 8.50 whereas, Group 2 which included teeth without pulpal calcifications showed a mean salivary pH of 7.9. Out of 100 patients examined, 60 patients reported with pulpal calcification out of which 19 were associated with caries in the respective teeth, on the other hand, 40 patients reported with no pulpal calcifications associated with or no caries. Conclusion: Within the limitations of the study, the results of the study indicated that salivary pH could be an important factor

in determining the prevalence of pulpal calcifications and could predict the possibility for future calcifications as well.

KEYWORDS : Dental caries, Orthopantomography, Pulp stone, Pulp calcification; Salivary pH

# INTRODUCTION

Pulp stones are calcified masses seen in the dental pulp of healthy, unerupted or diseased teeth (Baghdady et al. 1988). They are histologically classified into true or false forms (Kronfeld 1933). The true pulp stones contain irregular dentin whereas the false pulp stones are degenerative pulpal calcifications. The prevalence of pulp stone varies from 20% to 25% based on radiographic examination (Moss-Salentijn & Klyvert 1983).

The etiological factors for the pulp stone formation are yet not well understood, although, few factors have been implicated in stone formation. The various etiological factors involved include pulp degeneration, age (Hillmann & Geurtsen 1997), circulatory disturbances in pulp (Sundell et al. 1968), orthodontic tooth movement (Stenvik & Mjör 1970), idiopathic factors (Siskos & Georgopoulou 1990), genetic predisposition (VanDenBerghe et al. 1999), long standing irritants such as deep fillings, caries, chronic inflammation and periodontal disease (Kronfeld 1933) and long-term use of medications such as glucocorticoids and statins.

Saliva plays a very important role in maintaining the integrity of dental tissues. It comprises of calcium, phosphorous and other inorganic ions that facilitates the remineralization of the

demineralized enamel. Saliva has the ability to buffer acids which is essential for maintaining pH values in the oral environment. Bicarbonate ions play a major role in determining the pH and buffering capacity of saliva that can help protect teeth against attack from acids produced by bacteria. Saliva is known to represent all the ions present in the body fluids, and therefore, is considered to be its equivalent.

As the relationship between salivary pH and caries is well understood, with an increased prevalence of caries in low pH ( 5.5) conditions, it has also been observed that these carious lesions act as an irritant to dental pulp leading to occurrence of pulpal calcifications. However, since there have been studies concluding no significant relationship between carious lesions and presence of pulpal calcifications, in this study, we aim to correlate the influence of oral environment (saliva) and internal factors (caries) on presence of pulpal calcifications. Therefore, the aim of the study to correlate the relationship of pH of saliva to the presence of pulpal calcifications.

# MATERIALS AND METHODS

A sample size of 100 patients seeking treatment in FDS, Ramaiah University of Applied Sciences were included in the study. The study protocol describing the specimen collection was approved by the University Ethics Committee of Human Trials of Ramaiah University. The patients falling under age range of 18 -35 years and those advised for orthopantomogram were included in the study. Patients with any systemic disorders, patients undergone or undergoing orthodontic treatment and patients who suffered dentofacial trauma were excluded from the study. Patients who met the inclusion criteria and agreed to take part in the study were asked to sign the written informed consent. The detailed medical and dental history was obtained from each patient.

**Collection of saliva and pH determination**: 5 mL unstimulated saliva was collected in a sterile plastic container. The collected saliva was tested for pH using a digital pH meter (pHep by HANNA) as seen in figure 1. The pH readings were recorded and were grouped under the following categories:

- 1. Acidic ( 7.45)
- 2. Neutral (7.35 to 7.45)
- 3. Alkaline ( 7.45)



Figure 1- Collected saliva tested using pH meter (pHep by HANNA)

Orthopantomogram (OPG) interpretation: The digital OPG of each patient as shown in figure 2 was analyzed and interpreted based on presence of pulpal calcifications and presence of carious lesions. The pulpal calcifications were analyzed through presence of any radiopacity in the pulp chamber, narrowing of the root canals and recession of the pulpal horns. Carious lesions were evaluated with the presence of radiolucency involving either enamel, dentin or pulp.



Figure 2- Orthopantomogram revealing pulpal calcifications present in the pulp chamber of the teeth

Based on the presence/absence of pulpal calcifications, the samples were grouped into the following- Group A: samples with pulpal calcifications and Group B: samples without pulpal calcifications as shown below-



## Statistical analysis

Statistical analysis was performed using Paired Student's t-Test and SPSS Version 17.0

### RESULTS

It was observed, out of 100 patients, 60 patients presented with pulpal calcifications in their teeth, and therefore were categorized as Group A. The remaining 40 patients were included in Group B.

In Group A, a mean salivary pH of 8.50 was detected, whereas, in Group B a mean salivary pH value of 7.98 was observed. This can be appreciated in Table 1 and Table 2 respectively and is represented in the bar diagram given in Figure 3.

### Group A:

	Cases						
	Included			Excluded		Total	
	Ν	Percent	N		Percent	N	Percent
Group A (with pulpal calcification)	60	100.0%		0	0.0%	60	100.0%
	N			Std. Deviation			
Mean		Ν		Ś	Std. D	eviat	ion

### Table 1-Mean salivary pH in Group A (n=60)

Group B:

	Cases						
	Included		Excluded		Total		
	Ν	Percent	N		Percent	N	Percent
Group B (without pulpal calcification)	40	100.0%		0	0.0%	40	100.0%
	-		_				_
Mean	N			Std. Deviation			ion
7 980000	40		.2963020				

Table 2-Mean salivary pH in Group B (n=40)



Figure 3- Correlation between salivary pH and pulpal calcifications

Out of 60 patients examined, 19 patients reported with pulpal calcification associated with caries in the respective teeth, on the other hand, only 41 patients reported with only pulpal calcification and no caries present, as shown in Figure 4.



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### DISCUSSION

The present study aimed to associate the presence of pulpal calcification with salivary pH, considering the importance of the role of pH of saliva in demineralization and dental caries which in turn has a role to play in pulpal calcification. In this study saliva is taken as an external factor and dental caries as an internal factor to evaluate its effect on pulpal calcification. There are literatures on association of salivary pH and dental caries or dental caries and pulpal calcification but none of the study focused on correlating all the parameters.

The present study showed no significant association between pulp stones and caries but there was a relationship between higher salivary pH and pulpal calcification. This finding is in accordance with the study carried out by Gulsahi et al. 2009, in which, the authors found no significant relationship between pulp stones and caries (Gulsahi et al. 2009).

Group A with pulpal calcification resulted in mean salivary pH of 8.50 whereas Group B without calcifications reported salivary pH of 7.98. The possible reason for the difference in the result could be attributed to increased alkaline phosphatase activity not due to caries or restoration but due to higher alkaline pH of the saliva. There was a study reported by Tatsu et al. 2006 that alkaline phosphatase activity in human dental pulp cells in the pH 7.8 conditioned medium was significantly higher than in the pH 7.2 conditioned medium. This study concluded that alkaline phosphatase activity of human dental pulp cells was increased by alkaline pH stimulation (Okabe et al. 2006). Also, Kanasugi et al. suggested that the ALP activity of human dental pulp cells is enhanced by increased pH when calcium hydroxide is used as a pulp capping material (Kanasugi 1997).

Saliva is a complex body fluid that provides a general protective function for exposed oral hard tissues. The pH of saliva plays a very important role in the prevention of dental caries. It balances the demineralization and remineralization cycle present in the oral cavity (Singh et al. 2015). Therefore, in the present study, saliva was used as a diagnostic tool due to its easy availability. The pH of saliva was determined using electrode pH meter.

Age is considered to be an important etiological factor for the presence of pulpal calcifications. These calcifications have been observed to increase in frequency with increasing age. pulpal calcification in older age could be attributed to higher alkaline phosphatase activity (**Ma et al.**) In this study, in order to evaluate the correlation between salivary pH and pulpal calcifications, a strict inclusion criterion of limiting the age range of 18 to 35 years was done.

In this study, full mouth radiographs have been used to evaluate the presence of pulpal calcification and dental caries. According to literature, the ranges of sensitivity and specificity values of diagnostic methods are quite broad in terms of caries diagnosis, but the best specificity value belongs to radiographs in diagnosis of caries.

Small calcified structures with a diameter of less than  $200 \,\mu m$  cannot be detected on periapical radiographs and with this technique, a limited number of sections through a given tooth can only be made, thus, a significant number of calcified structures could be missed. This could lead to underreporting of the incidence of pulpal calcifications. Bitewing radiographs, on the other hand could have also been used, but this would have limited the examination to the crown only. Therefore, in this study, orthopantomogram was used to detect the presence of pulpal calcifications.

Tamse et al. 1982, evaluated full mouth radiographs of 300 patients and reported that 21% had pulp stones. In another

study pulp stones were found in 12% of the patients and 5% of the teeth using full mouth periapical radiographs (**Gulsahi et al. 2009**). It was concluded from these studies, that, such findings from related studies, should be compared carefully due to the variations in the sampling procedures and type of radiographs examined.

In the current study, Both the anterior and posterior teeth were examined for pulpal calcifications. Inter-observer agreement value was almost perfect in determining pulp chamber calcifications through radiographic interpretation. Therefore, the calibration of the observers was good in this study.

### CONCLUSION

Within the limitation of the study, it can be concluded that salivary pH may have a role to play in formation of pulpal calcifications. The calcification of pulp is a consequence of chronic inflammation, dystrophic calcification or influenced by external factor is still a question. Further study should be done to validate the findings. The role of odontoblasts, fibroblasts and alkaline phosphatase activity in pulpal calcifications at molecular level to be evaluated.

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