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Original Article

Is there a relation between dental calculus and kidney stone?

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Abstract

Aim: The purpose of this research is to investigate the frequency of dental calculus in patients with kidney stone and without kidney stone.

Methodology: Two hundred eighty-seven patients (143 men and 144 women) aged between 18 and 68 (mean age 38.38±13.74) were included in the study. Patients were divided two groups in which 143 subjects without kidney stones (group I) and 144 subject with kidney stones (group II). Intra-group and inter-group analyzes were performed in terms of periodontal status and dental calculus index according to educational level, frequency of toothbrushing and smoking.

Results: The study sample consisted of 287 patients which 143 in group I, 144 in group II. The mean age of the group I was 36.77±12.81 years old, and group II was 39.98±14.47 years old. There was a statistically significant difference between periodontal status and education level, daily tooth brushing and smoking in group I and group II ($p<0.05$). Both in group I and group II there was a statistically significant difference periodontal calculus index and education level, smoking, daily tooth brushing ($p<0.05$). In addition, there were significant correlations between dental calculus index and size of the kidney stone.

Conclusion: There is a significant difference between the groups in terms of dental calculus index. There is a need for additional study on this subject in the future.

Keywords: dental calculus, kidney stone, nanobacteria

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Introduction

Biomineralization of calcium causes many illness like, periodontal disease, renal stone, chronic pancreatitis, rheumatoid arthritis, atherosclerosis in the body (1).

Calcifications in the urinary system are a common disease that causes high morbidity and its incidence has been increasing in recent years (2). Although several researches have been conducted to investigate the pathogenesis and treatment of calcifications in the urinary system, the specific mechanism is still unclear. (3). Previous studies have shown that nanobacteria are effective in the mineralization of calcium and phosphate, suggesting that nanobacteria may contribute to urolithiasis (1).

The process of dental calculus formation starts with the deposition of saliva or gingival crevicular fluid minerals onto the organic layer of pellicle that covers the tooth

surfaces. This calcifications stage of dental calculus is same to that of other ectopic mineralizations, like renal stones and bile stones (4). This relationship may reveal the hypothesis that these calcifications occurring in different parts of the body can be caused by a common cause. The identification of a specific microorganism in kidney stones, dental pulp stone (1) atherosclerotic plaques (5) may support this thought (4). Microorganisms have been shown to be an effective factor in the formation of dental plaque calcification as it is in kidney stones (1). Therefore, the aim of the present research is to investigate the frequency of dental calculus in patients with kidney stone and without kidney stone according to educational level, smoking and toothbrushing.

Materials and Methods

Study population

The cross-sectional research was conducted at the Departments of Urology and Periodontology. Two hundred eighty seven patients (143 men and 144 women) aged between 18 and 68 (mean age 38.38±13.74) were included in the study. Patients were divied two groups, in which 143 subjects without kidney stones (Group I) and 144 subject with kidney stones (Group II). Approval to use these teeth in the study was granted by the Ethics Committee of Fırat University, Faculty of Medicine (approval number: (2021/08-44). All participants voluntarily participated in this study. Participants were informed about the nature of the study through both written and verbal communication. Later, the participants who agreed to take part in the study filled out the questionnaires.

Urologic examination

One thousand one hundred and fifteen patients who applied to the urology clinic for various reasons were performed urological examinations. After ultrasonographic examination, 169 patients with kidney stone were found but 144 patients with kidney stone and 143 patients without kidney stone were agreed to participate in the study. The feature of kidney stone such as opacity, size and hounsfield were recorded. Patients with calcium metabolism disorder were excluded from the study.

Prior to, dental examination, all patients' demographic data, toothbrushing frequency and smoking habit, detailed medical history and the etiology of the renal disease were recorded.

Intraoral examination

Clinical examination included evaluation of periodontal status and patients were divied into three groups according to their periodontal status such as healthy, gingivitis and chronic periodontitis. Community Periodontal Index (CPI) probe and an intraoral mirror were used to make examination in accordance with World Health Organization criteria and methods. (6).

The amount of calculus accumulation was determined by the Volpe-Manhold Index (VMI) (7). It was determined by measuring the height of the calculus accumulated in the lingual surface region of the anterior lower teeth using a periodontal probe. The measurement was recorded in millimeters per tooth (7).

The intraoral examination was performed by a single calibrated periodontist (T.T.Y). The calibration was carried out on a pilot study for dental calculus, periodontal status (intra-observer agreement of 0.85), measurements at the department of periodontology.

Statistical analysis

Analysis of the data was carried out with IBM SPSS Version 22 (IBM SPSS Inc., Armonk, NY, USA). Variables were described as mean± Standard deviation (SD). Chi-square test was used to detect the association between periodontal status, dental calculus index and educational level, smoking, frequency of toothbrushing in groups. A significant difference among the mean values of dental calculus index were tested by means of the one-way analysis of variance (ANOVA). A correlation between the dental calculus index and opacity, size and hounsfield were tested for statistical significance by means of the Pearson's correlation test. Differences of gender, height, weight and age were performed using the Student's t-test. ANOVA was performed to assess age differences. $P<0.05$ was accepted as statistical significant.

Results

This research sample consisted of 287 patients which 143 in group I, 144 in group II. The mean age of the group I was 36.77±12.81 years old, and group II was 39.98±14.47 years old. Group I was consisted of 74 (%51.7) males and 69 (%48.3) females, group II was consisted of 70 (%48.6) males and 74 (%51.4) females. No difference was observed between groups in relation to age, gender, height, and weight ($p>0.05$) (Table 1).

The findings of periodontal status are given in Table 2. There was a statistically significant difference periodontal status and education level, daily toothbrushing and smoking in group I ($p<0.05$). In group II there was a statistically significant difference periodontal status and education level, smoking, daily toothbrushing ($p< 0.05$) (Table 2). No significant difference were detected in periodontal status between groups ($p>0.05$).

The analysis of the dental calculus index between groups shown significant difference ($p<0.05$) (Table 3). Both in group I and group II there was a statistically significant difference periodontal calculus index and education level, smoking, daily toothbrushing ($p<0.05$). Additionally, a positive correlation was detected between dental calculus index and size of the kidney stone ($r=0.817$, $p=0.001$) but any statistically significant correlation was found among dental calculus indexs and opacity, hounsfield of kidney stone ($p>0.05$) (Table 4).

Table 1. Comparison of demographic data between groups

Demographic data	group I	group II	p
Male	74	70	0.595
Female	69	74	0.601
Age	36.77± 12.81	39.98±14.47	0.05
Height	167.51±6.97	167.02±10.53	0.175
Weight	70.44±9.57	72.29±10.47	0.114

*Presents statistical significance

Table 2. The relationship between periodontal status and education level, smoking, brushing

	Periodontal status							
Variable	Group I				Group II			
	Healty	Gingivitis	Periodontitis	p	Healthy	Gingivitis	Periodontitis	p*
Education level								
Primary school	0 (%0.0)	11(%27.5)	50(%63.3)	0.001*	0(%0.0)	0(%0.0)	18(%75)	0.001*
Secondary school	0 (%0.0)	7(%17.5)	29(%36.7)		0(%0.0)	7(%16.7)	33(%42.3)	
High school	18(%75)	19(%47.5)	0(%0.0)		18(%75)	19(%47.5)	7(%9)	
University	6(%25.0)	3(%7.5)	0(%0.0)		6(%25.0)	3(%7.5)	0(%0.0)	
Smoking								
Yes	4(%12.9)	5(%14.3)	35(%24.5)	0.067*	0(%0.0)	7(%16.7)	21(%26.9)	0.012*
No	27(%87.1)	30(%85.7)	54(%70.1)		24(%20.7)	35(%30.7)	57(%49.1)	
Brushing								
Once	3 (%9.7)	7(%20.0)	72(%93.5)	0.001*	4(%16.7)	7(%16.7)	66(%84.6)	0.001*
Twice	10(%32.3)	19(%54.3)	5(%6.5)		3(%12.5)	30(%71.4)	8(%10.3)	
Three times	15(%48.4)	7(%20.0)	0(%0.0)		14(%58.3)	3(%7.19	2(% 2.6)	
Four times	3(%9.7)	2(%5.7)	0(%0.0)		3(%12.5)	2(%4.8)	2(%2.6)	

*Presents statistical significance

Table 3. The relationship between dental calculus index and education level, smoking, brushing

Variable	Dental calculus index					
	n	Group I	p*	n	Group II	p*
Education level						
Primary school	61	2.67±0.53	0.001*	51	1.53±0.50	0.001*
Secondary school	36	2.48±0.53		40	1.73±0.46	
High school	37	0.98±0.88		44	0.64±0.58	
University	9	0.77±0.36		9	0.66±0.43	
Smoking						
Yes	32	2.61±0.43	0.002*	28	1.51±0.54	0.001*
No	111	1.91±1.07		116	1.20±0.72	
Brushing						
Once	82	2.63±0.62	0.001*	77	1.59±0.54	0.001*
Twice	34	1.87±0.75		41	1.07±0.56	
Three times	22	0.62±0.66		19	0.54±0.71	
Four times	5	0.59±0.36		7	0.63±0.77	

*Presents statistical significance

Table 4. The relationship between dental calculus and the kidney stone

Dental calculus index			
Kidney stone Variable	Pearson's Correlation Coefficient value	N	p value
Opacity	*0.043*	143	*0.610*
Size	0.817	143	0.001**
Hounsfield	*0.014*	*143*	*0.869*

** Correlation is significant at the 0.01 level

* Correlation is significant at the 0.05 level

Discussion

In this research, patients with kidney stone showed to increase calculus accumulation when compared to patients without kidney stone. This may be due to the differences related to microorganisms that have an effect on calcification. Although there is a lot of related research between dental calculus and different calcifications such as atherosclerotic plaques (8), dental pulp stone in the body, to best of our knowledge no research has been published in the English literature related to the kidney stone.

Periodontal disease is defined as inflammation of the surrounding tissues that support the teeth and is divided into two subgroups as gingivitis and periodontitis. This inflammation may cause pocket formation, attachment and bone loss, and may result with tooth loss. Genetic, environmental and bacterial factors play role on periodontal diseases (4).

The results of this study are similar to the periodontal status of patients in both groups. But there was a significant association between the level of education and the frequency of toothbrushing in both groups. This result is associated with an increase in dental awareness as the level of education increases. Many studies on this subject have revealed a close relationship between periodontal health and dental awareness (6, 9). Tomozoni et al reported in compliance with this study, in which education and socioeconomic level were related to the amount of gingival bleeding (10). Additionally, Rodriguez et al observed that lower educational level as a strong risk factor for tooth loss and education level was a very important factor in increasing the level of awareness of oral diseases causing tooth loss (9).

The effect of cigarette on periodontal health is clear and, our results also showed a significant relationship between smoking and periodontal status consistent with the literature. Azizi et al. suggested that there was a positive relation between severity of smoking and periodontal disease (11).

The primary etiologic factors of periodontal disease is dental plaque. When dental plaque can not be removed from tooth surface, mineralization starts on dental plaque (4). Dental calculus formation starts with the deposition of saliva and gingival crevicular fluid minerals into the pellicle layer. Calcium phosphate crystals are deposited in the organic layer. This organic matrix layer contains not only microorganisms but also amorphous materials derived from oral liquids (12). It is very important to remove the dental plaque to prevent calculus formation (13). The finding of this research showed that the education level, smoking and tooth brushing frequency were effect dental calculus formation in both groups. As the level of education increases, the dental awarenes increases, and the patients are more conscious of their oral health. Patients with good oral hygiene habits are less likely to have detal plaque deposits associated with regular toothbrushing, so the dental calculus is less common in these patients (14).

Kidney stone is one of the oldest disease seen in humans. Epidemiologic studies have shown that anatomic defects, metabolic and genetic disorders are predisposing factors in only 10-20% of patients with kidney stones (15). Sometimes stones with an unknown reason can be created, such stones are called idiopathic. (16). Although the defense mechanisms leading to vascular calcification are not fully resolved, it is possible that nanobacteria capable of surface calcification in the presence of calcium and phosphate at the physiological level might play a key role in such tissue calcifications (17). In animal studies, evaluating the role of nanobacteria in renal pathologies, it is reported that nanobacteria has a toxic effect on fibroblasts in vitro and play a role in cyst formation. The intravenous nanobacteria injection accelerates biocrystallization and leads to calcification in the renal tubular structure (1). In terms of the pathogenesis of periodontal disease, the possible contribution of nanobacterial infections is mentioned in the calcifications observed during this period. Periodontal diseases are multifactorial pathologies that are the main cause of the dental plaque, defined as a collection of microorganisms adhered to the tooth surface, embedded in bacteria, bacterial products and host cell based polymer matrix (18). If the dental plaque structure is not eliminated, calcium phosphate crystals precipitate on saliva and gingival fluid based amorphous material and organic plaque matrix containing microorganisms. A mineralization process similar to ectopic calcifications like renal stones begins (19). The association of nanobacteria with such ectopic calcifications and the evidences suggested that they may be effective in dental calculus calcification, and may be a risk factor for periodontal disease (4). The finding of our research suggest that there was a strong correlation between the dental calculus and the kidney stone. We think that this result might be related to the nanobacteria, as in previous studies (20).

The nanobacterial infections, whose efficacy is discussed in the calcification process of atherosclerotic, renal and periodontal pathologies, might be considered as a common risk factor (4). A more extensive study of this topic can be planned in the future.

Conclusions

The present study shows that dental calculus is strongly associated with kidney stone. There is a significant difference between the groups in terms of dental calculus index.

Ethical Approval: Ethics committee approval was received for this study from Fırat University, Faculty of Dentistry in accordance the World Medical Association Declaration of Helsinki, with the approval number: 2021/08-44.

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