



Influence of Diet and Oral Care Applications on Oral Health in Client-Owned Dogs

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The purpose of this study was to demonstrate the clinical significance of the effects of diet, toothbrushing, and chewing materials on oral health, based on clinical examination findings. In the study, 50 small or medium dogs and 50 large dogs were used, from different breeds, from different ages and both sexes. 23 of the dogs were fed with soft food, 32 with dry food and 45 with dry and soft food. In 26 of the dogs teeth were brushing 1-2 times a week, and 48 of the dogs were given chewing material rarely. In physical examination, the severity of gingival disorders (redness, swelling, pain, bleeding), plaque and tartar accumulation rate on teeth and the growth of mandibular lymph node were evaluated. There was no statistically significant difference between the groups in terms of the kinds of food, toothbrushing 1-2 times a week and giving chewing materials occasionally. In the groups of large and small-medium dogs, statistically significant differences were found ($P<0.05$) between Dental Disturbance Scores (DDS) 0.1 scores and DDS 2 score and also between the Mandibular Lymph Node Disturbance Scores (MLDS) 0, 1 scores and MLDS 2 score. In conclusion, as a clinician, it is important to consider age and mandibular lymph node growth when examining oral health in dogs.

Key Words: Dogs, foods, oral care applications, oral health

Sahipli köpeklerde diyet ve oral bakım uygulamalarının ağız sağlığına etkisi

Bu çalışmanın amacı, klinik muayene bulguları dikkate alınarak diyetin, diş fırçalamanın ve çiğneme materyallerinin ağız sağlığına etkisinin klinik önemini ortaya koymaktır. Çalışmada, farklı ırklardan, farklı yaşta ve her iki cinsiyetten olmak üzere 50'si küçük veya orta ırktan köpek ve 50'si büyük ırktan köpek kullanıldı. Köpeklerin 23'ü yumuşak gıdalarla, 32'si kuru gıdayla ve 45'i kuru ve yumuşak gıdalarla beslenmekteydi. Köpeklerin 26'sında dişler haftada 1-2 kez fırçalanmaktaydı ve köpeklerin 48'ine seyrek olarak çiğneme malzemeleri verilmekteydi. Fiziksel muayenede, diş eti bozukluklarının şiddeti (kızarıklık, şişme, ağrı, kanama), dişlerde plak ve tartar birikim oranı ve mandibular lenf nodunun büyümesi değerlendirildi. Klinik muayene bulguları skorları dikkate alınarak yapılan değerlendirmede, tüm yaş grupları arasında önemli fark bulundu ($P<0.05$). Ağız sağlığına etki bakımından gıda çeşidinin, dişleri haftada 1-2 kez fırçalamanın ve çiğneme materyalinin bazan verilmesi gruplar arasında istatistiksel olarak önemli bir farka neden olmadı. Büyük ve küçük veya orta köpek gruplarında, Dişeti Bozukluk Skoru 0,1 ve Dişeti Bozukluk Skoru 2 olarak skorlandırılan olgu sayıları arasında, ve aynı gruplarda Alt Çene Lenf Yumrusu Bozukluk Skoru 0, 1 ve Alt Çene Lenf Yumrusu Bozukluk Skoru 2 olarak skorlandırılan olgu sayıları arasında önemli istatistiksel fark saptandı ($P<0.05$). Sonuçta, klinikçi olarak köpeklerde ağız sağlığını incelerken yaş ve mandibular lenf nodu büyümesinin göz önüne alınmasının önemli olduğu sonucuna varılmıştır.

Anahtar Kelimeler: Köpekler, gıdalar, ağız bakımı uygulamaları, ağız sağlığı

Introduction

Oral health disorders in dogs is one of the most important problems that start with dental plaque, tartar buildup and gingivitis, resulting in periodontitis and tooth loss and general health disturbances (1- 6).

Dietary regimen and oral care applications have significant influence on the occurrence of dental plaque and calculus (7-10). Gingivitis first occurs in the superficial tissues, then in the deep tissues leading to the onset of inflammatory lesions in the remote organs (2, 3, 6, 11). Poor oral health in dogs, causes halitosis, chewing difficulty, stress and sociological problems. The quality of life of the dogs is reduced (4, 12-15). Periodontal diseases are seen more commonly in small dogs than large ones and in older animals than young ones, and as dogs get older, there is a gradual increase in the severity of periodontitis (1, 4, 5, 13, 16-20).

Nutritional habits are responsible for the formation of periodontal diseases, and in general, feeding with soft foods increase the likelihood of the oral disturbances (7, 18, 21). Regular brushing of the dog's teeth (8, 10, 15, 20-22), proper habit of giving chewing materials (3, 18, 23), reducing the risk of the development of periodontal disorders (5, 8, 10, 13). It has been postulated that stress has some effects on the progression of oral disturbances (12).

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In the early stage of the disease, dental plaque formation, mild redness and swelling in gingival tissue are noticed (5, 19). With the progression of inflammation, severe redness, hypersensitivity, swelling and bleeding in gingival tissue develops (4, 15). The other clinical findings in these cases are tartar formation, mandibular lymph node growth and general status disorders (13, 24).

The oral health index score is used in order to evaluate the oral health in dogs. The following criteria are taken into consideration for determining the oral health index scores; 1. The severity of clinical symptoms of gingivitis, 2. The rate of accumulation of plaque and tartar on teeth, 3. The grades of lymph node growth (20, 25).

The most effective practices to prevent or delay the development of oral health disorders in dogs are to brush the teeth continuously (8, 10, 15, 20) and to give chewing materials after feedings, as much as possible (14, 20, 23, 26). Different ideas about the influence of the type of foods on oral health have been put forward (7, 9, 22, 24). While some researchers point out that the influence of the kinds of foods on oral health are limited (7, 9, 24), some researchers indicate that dry commercial foods are useful for the protection of oral health (7, 8, 18, 27, 28). The other researchers have indicated that soft foods have significant contributions to the deterioration of oral health (7, 28).

Materials and Methods

In the dogs brought to the clinic; to analyze the effects of age, body size, diet, tooth brushing and chewing materials on oral health and to show the clinical importance of these factors; Information was collected from the dog owners about the breed, age, gender, frequency of daily diet and oral care practices (toothbrushing and chewing materials).

At the physical examination, the severity of the gingival disorders (redness, swelling, pain, bleeding), the rate of the accumulation of the plaque and tartar on teeth and the grades of mandibular lymph node growth were determined. The grades of these disorders were scored as 0, 1, 2, and the sum of these scores for each case, was evaluated as an oral health index score that was graded as between 0-6 (20, 25).

The following criteria were taken into account while scoring the clinical findings of oral disorders. The scores of the accumulations of the plaque and tartar on teeth (DDS) were classified as (0), (1) and (2) according to the rate of deposits of plaque and tartar on the teeth. Score (0): No plaque and tartar accumulation on teeth; Score (1): The plaque and tartar accumulation have covered the half of the visible part of the teeth; Score (2): The plaque and tartar accumulation have covered more than the half of the visible part of the teeth. Gingival disturbances scores (GDS) were scored as (0), (1) and (2) according to the degree of impairment. Score (0): No gingival disturbances. Score (1): Mild redness and swelling in the gums. Score (2): Severe redness, swelling, pain and gingival bleeding. Mandibular lymph

node disturbance scores (MLDS) were scored as (0), (1) and (2) according to the grades of the lymph node growth. Score (0): No growth; Score (1): There is slight growth; Score (2): There is severe growth. Oral health index scores (OHIS) are the sum of the scores of DDS, GDS and MLDS, and are graded as between 0 and 6. The score '0' means good oral health. The scores from 1 to 6 indicate the gradual increase in the severity of oral health disorders. Expressions about the severity of oral health impairment were classified as follows; 1. OHIS-1,2,3 indicate the 'mild degree' oral health disorder, 2. OHIS-4 indicates the 'moderate degree' oral health disorder and 3. OHIS-5, 6 indicate the 'severe degree' oral health disorder (20, 25).

In the statistical analysis of the results given in the tables, 'One Way Variance Analysis' was used. The 'Duncan test' was used to determine the differences between subgroups. SPSS 11.5 packet computer program was used for all statistics. Each test item group value in each row between the subject items in each row was tested by chi-square analysis between them.

Results

Of the a total of 100 dogs, included in this study, 31 were Terrier, 19 were mixed breed, 12 were Golden Retriever, 8 were Kangal, 30 were from the different breeds of dogs (consisting of 1 to 4 dogs). Of the 100 dogs; 53 were male and 47 were female; 50 were small-medium dogs (small dogs were <10 kg body weight, medium dogs <25 kg body weight), 50 were large dogs (>25 kg body weight); 15 were <1 year old, 25 were 1-3 years old, 36 were >3-7 years old, 24 were >7 years old.

According to the information from the animal owners, 32 dogs have been fed with dry foods, 23 dogs have been fed with soft foods and 45 dogs have been fed with both dry and soft foods. Dry foods have included commercial foods. Soft foods have included both commercial canned foods and homemade foods. In 26 dogs, teeth have been brushed 1-2 times in a week after feedings, and 48 dogs have been sometimes given chewing materials between the times of feeding.

The distribution of the mean oral health index scores according to the age range were showed in Table 1. Mild oral health disorders begin to develop at <1 year old and the severity of the disorders increases with age, Most of the dogs of >7 years old, have severe oral health disorders. There was significant statistical differences ($P<0.05$), between the numbers of the cases in the each clinical examination finding scores and age groups.

The distribution of the oral health index scores according to the sizes of the dogs were showed in Table 2 and Table 3. As a result, it can be said that small or medium breed dogs are more susceptible to the formation of oral health disorders than large dogs, but no significance found between groups. Significant statistical differences ($P<0.05$) were found in the group of large dogs and the group of the small or medium dogs between the DDS 0,1 score and the DDS 2 score and between the MLDS 0, 1 score and the MLDS 2 score.

The distribution of the oral health index scores according to the diet regimens were showed in Table 4 and Table 5. There was no statistically significant difference between the groups in terms of the kinds of food.

The distribution of the oral health index scores according to the toothbrushing were showed in Table 6. There was no statistically significant difference between

the groups in terms of the toothbrushing 1-2 times a week

The distribution of the oral health index scores according to the giving chewing materials were showed in Table 6. There was no statistically significant difference between the groups in terms of the giving chewing materials occasionally.

Table 1. Relationships between the ages and the oral health index scores (OHIS)

Age	n	%	OHIS x±Sx	Min-max	Statistical significance (P)
<1	15	15	0.93±0.284 ^c	0 - 3	0.001
1-<3	25	25	1.88±0.185 ^b	0 - 3	
3-7	36	36	2.42±0.205 ^b	0 - 6	
>7	24	24	3.67±0.374 ^a	0 - 6	
Total	100	100	2.36±0.157	0 - 6	0.000

a,b,c,: The averages with different letters in the same column are different (P<0.05).

Table 2. Relationships between the small-medium dogs, large dogs and gingival disturbances scores (GDS), dental accumulation scores (DDS) and mandibular lymph node growth scores (MLDS)

The Scores of oral disturbances and mandibular lymph node growth	GDS				DDS					MLDS					
	0	1	2	Tn	0	1	2	0.1	Tn	0	1	2	0.1	Tn	
Sizes of dogs	n	9	26	15	50	7	33	10	40	50	35	7	8	42	50
Small-medium dogs	%(1)	42.9	46.4	65.2		33.3	49.3	83.3	**80		52.2	30.4	80.00	**84	
	n	12	30	8	50	14	34	2	48	50	32	16	2	48	50
Large dogs	%	57.1	53.6	34.8		66.7	50.7	16.7	**96		47.8	69.6	20.00	**96	
					100			**4		100			**4		100

Tn: Total number

(1): Frequencies were calculated for those who were scored as GDS, DDS and MLDS (for example, in Small-medium group, the frequency for GDS-0 were 9 / 21x100= 42.85 %).

*: The sizes of the dogs between each row; And values of each Score of gingival disturbances (GDS) and dental disturbances (DDS) and mandibular lymph node growth (MLDS) in the groups of dogs in each column; were tested among themselves by chi-square analysis.

Between the MLDS 0, 1 score and MLDS 2 score, in the group of the small or medium dogs and in the group of the large dogs, was found significant differences (P<0.05).

Between the DDS 0, 1 score and DDS 2 score, in the group of the small or medium dogs and in the group of the large dogs, was found significant differences (P<0.05).

Table 3. Relationships between the small-medium dogs, large dogs and oral health index scores (OHIS)

Sizes of dogs		OHIS						Total
		0	1	2	3	4	6	n
Small-medium dogs	n	4	4	22	9	1	10	50
	%(1)	30.76	40.00	59.45	36.00	33.33	83.33	100
Large dogs	n	9	6	15	16	2	2	50
	%	69.23	60.00	40.54	64.00	66.66	16.66	100

(1): Frequencies were calculated for those who were scored as OHIS (for example, in Small-medium group, the frequency for OHIS-0 were 5/ 13x100 = 38.46%)

*: The sizes of the dogs between each row; and values of each score of oral health index scores (OHIS) of the groups in each column; were tested among themselves by chi-square analysis. No group frequencies were statistically different.

Table 4. Relationships between the kinds of foods given the dogs and gingival disturbances scores (GDS), dental accumulation scores (DDS) and mandibular lymph node growth scores (MLDS)

Scores of oral disturbances and mandibular lymph node growth	Dry foods		Soft foods		Dry-soft foods		Total
	n	% (1)	n	%	n	%	
GDS-0	7	21.87	4	17.39	10	22.22	21
GDS-1,2	25	78.12	19	82.60	35	77.77	79
DDS-0	7	21.87	3	13.04	10	22.22	20
DDS-1,2	25	78.12	20	86.95	35	77.77	80
MLDS-0	26	81.25	13	56.52	26	57.77	65
MLDS-1, 2	6	18.75	10	43.47	19	42.22	35
Total	32	100	23	100	45	100	100

(1): Frequencies were calculated for those who were fed with each food for example, PBS-0 frequency were $7 / 32 \times 100 = 21.87\%$ in dry foods)

*: Foods between each row; and the values of scores of GDS, DDS and MLDS groups in each column; were tested among themselves by chi-square analysis. No group frequencies were statistically different.

Table 5. Relationships between the kinds of foods and oral health index scores (OHIS) in dogs

Food types	n	%	OHIS $\bar{x} \pm S_x$	Min-max	Statistical significance (P)
Dry	32	32	1.88±0.178	0 - 3	ÖD
Soft	23	23	2.48±0.332	0 - 6	
Dry-soft	45	45	2.53±0.255	0 - 6	
Total	100	100	2.31±0.151	0 - 6	0.140

ÖD: Not important; There was no statistically significant difference between the groups of dogs given different kinds of foods in terms of OHIS averages (P= 0.140).

Table 6. Relationship between the dogs whose teeth being brushed and given chewing materials and the gingival disturbances scores (GDS), dental accumulation scores (DDS) and mandibular lymph node growth scores (MLDS)

Oral care applications Scores of oral disturbances and mandibular lymph node growth	Toothbrushing					Chewing materials				
	No tooth brushing		Tooth brushing with 1-2 times in a week			No chewing materials		Chewing materials being given occasionally		
	n	%1	n	%	Total	n	%	n	%	Total
GDS-0	17	80.95	4	19.04	21	12	57.14	9	42.85	21
GDS-1,2	57	72.15	22	27.84	79	40	50.63	39	49.36	79
DDS-0	17	85.00	3	15.00	20	8	40.00	12	60.00	20
DDS-1,2	57	71.25	23	28.75	80	44	55.00	36	45.00	80
MLDS-0	46	71.87	18	28.12	64	33	51.56	31	48.43	64
MLDS-1,2	28	77.77	8	22.22	36	19	52.77	17	47.22	36
Total	74	100	26	100	100	52	100	48	100	100

(1): Frequencies are calculated for those whose teeth have been brushed and have not brushed and for those who chewing materials have been given occasionally and chewing materials have not been given. (For example, GB-0 frequency was $17 / 21 \times 100 = 80.95\%$ in the group of dogs whose teeth have not been brushed).

*: Tooth brushing between each row; and the values in each scores of oral disturbances and mandibular lymph node growth groups in each column; were tested among themselves by chi-square analysis. No group frequencies were found statistically different.

Discussion

The protection of oral health in the dogs is important for a long and healthy life (1, 3, 4, 13, 14). The types of daily consumed foods (7, 9, 18, 24) that cause the plaque and tartar formation on teeth and gums, and the deficiency of the oral care practices (7, 9), are most important factors affecting the oral health. Oral plaques and tartar cause gingivitis initially, then periodontitis and eventually results in loosens and lose of teeth (7, 9, 17, 19). During the development period of chronic periodontitis, oral pathology-induced toxi-infectious

disorders in the other organs of the body have been shown with pathologic examinations (2, 3, 6, 8, 11, 15).

Some symptoms that can be seen in dogs with oral health disorders are halitosis, difficulty in eating hard foods, restlessness and nervous behavior (3, 4, 11-15). Although there are no studies investigating the relationship between the oral health disorders and the quality of the life in dogs, there are studies that state that halitosis in dogs is a disturbing condition for humans and that some applications must be made to correct this condition (4, 14, 15, 26). In this study, it was learned

that, the dogs with impaired oral health were more restless than those in the past, and their association with human due to the bad breath was reduced. According to the grades of oral disorders, the dogs had some difficulty in chewing their foods and they were not friendly to the dogs and people around them. Information about the increased frequency of taking dogs to the veterinary clinics, was recently received due to the onset of abnormalities in general health status.

Some of the factors that affect the oral health of dogs, are the breed, age, mouth structure (1, 5, 17, 19, 20), the types of the foods and the oral care practices (7, 21, 27, 28).

Several articles have reported that plaque and tartar on teeth and some clinical findings of periodontitis may be seen in dogs of all ages (1, 5, 20). When clinical findings of oral health disorders are evaluated according to the age groups in dogs in this study (Table 1), there was a significant statistical difference ($> 0,05$) between the number of patients with clinical examination findings scores and age groups. This interpretation resembles to that of some researchers' indicating that the grades of severity of periodontal disorders increases with age, and causes serious mouth problems in dogs over 5 years of age (5, 19, 20).

Although the numbers and the severity of the cases of periodontal disorders were reported to be higher in small dogs than those in large dogs (1, 5, 13, 17), in our study, as shown in the Table 2, and Table 3; it was showed that the number of the cases with oral health disturbances are high both in small-medium dogs and in large dogs. But the severity of oral health impairment in the large dogs was found less than those in the small or medium dogs. This difference between the small or medium and large dogs may be attributed to the differences in the mouth and dental structures of the dogs, in the types of foods, in the ability to chew the foods and in the individual local and general immune status. According to the distribution of the numbers of the cases in the small or medium breed dogs, although no significance were found between groups, it can be said that small or medium dogs are more susceptible to the formation of oral health disorders than the large dogs.

The researchers point out that the numbers of the cases of periodontal disorders observed in dogs increase markedly from the age of 2-3 years old and that the severity of these disorders increases gradually from the age of 5 years old (1, 16, 17, 19, 20). In this study, as can be understood from the Table 1; periodontal disorders began to be seen from the age of <1 year old. As the age progressed, the number and severity of the oral health impairment increased. Almost all dogs of >7 years old, have been found to have a moderate-to-severe oral health impairment. This finding, is consistent with the common idea that periodontal disorders are the most important problem that arises in older dogs, especially in small ones (1, 5, 20).

Similar to the reports of that 'during the course of periodontitis in the dogs, variable degree of growth in mandibular lymph node and deterioration in general health condition develop' (2-4, 6, 27), this study showed that the mandibular lymph node begins to grow from the age of <1 year old dogs with mild degree oral health disorder. The greater growth of mandibular lymph nodes in older dogs may be attributed to the greater severity of oral health disorders (Table 2).

The results of the evaluation of OHIS numbers showed that the mouth disorders in dogs can not reach to a severe degree due to the strengthening of individual immunity from 1 year to 3 years. The probability of the lack of adequate sensitivity to protect oral health, the inability to maintain continuity of oral care practices, increase the severity of the mouth disorders inevitably. In addition to the other reasons, since the immune system begins to weak in almost all dogs over the age of >7, there is a greater likelihood of suffering from moderate-severe illness in the mouth following 7 years old in dogs. Similar comments from previous studies have shown that severe periodontal disorders begin to occur for a variety of reasons, such as immune system disorders in dogs of 2-3 years old, and in addition, one of the greatest problems of older dogs is severe periodontal and tooth disturbances (1, 16, 19).

In studies, investigating the relationship between food type and oral health in dogs; Some researchers have indicated that commercial dry foods does not positively affect oral health (9, 18, 22, 24), while some researchers suggest that oral health is affected well in dogs given commercial dry foods (7, 8, 18, 24, 28), and a researcher (28) reported that commercial dry foods negatively affected oral health. The idea that soft foods have a bad influence on oral health is a common thought of among the researchers (7, 18, 22, 24, 26, 28). In this study, the results suggests that the consumption of the soft foods may have a little more bad effect on oral health than the other two kinds of food. There was also no statistically significant differences between the groups in terms of the kinds of food.

It is reported in some investigations that one of the most common practices for cleaning the food deposits in the mouth is to give the dogs some chewing materials that will encourage them to chewing (7, 17, 21, 23, 26, 28). In this study, unexpectedly an adequate decrease in the numbers of the cases with oral health disorders are not determined in the dogs given sometimes chewing materials. The probable cause of this may be that the animal owner's habit to give chewing material had not improved sufficiently.

In some investigations in the dogs, it is stated that if post-feeding toothbrushing are realized several times a week; the development of periodontal disorders is delayed to later ages, and that in cases of periodontitis development; the severity of symptoms appear to be milder than those in the dogs whose toothbrushing has never been performed (3, 7, 8, 10, 15, 20-22). In this study, similar comments can be made for the dogs

whose teeth have been brushed 1-2 times a week and for the dogs whose teeth have not been brushed.

The following conclusions can be made according to the results obtained from this study: Oral health disorders in dogs can be seen in the dogs from the age of >1 year old and the severity of the disorders increase with age. Severe oral health disorders begin to see at >3 years old. When the OHIS scores of the cases were evaluated, it can be said that most of the cases of >7 years old, have severe oral health disorders. In cases of severe oral health disorders, general health problems also arise and some sociological problems may encounter. Severe oral health disorders occur more

frequently in small or medium breed dogs. When the GDS and DDS scores are taken into consideration, oral health disorders occur more frequently and more severely in the dogs given soft foods. Tooth brushing, 1-2 times in a week, delay the development of oral health disorders. It can be said that the infrequent use of chewing materials in dogs between the feeding times has little effect on the protection of oral health.

In conclusion, when evaluating the oral health in dogs, according to the results of this study, it was concluded that consideration of the age range and mandibular lymph node growth findings by the clinicians is clinically useful to evaluate of the oral health.

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