Prevalence of dental disorders in pet dogs

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ABSTRACT: Oral disorders of the dog represent for veterinarians a medical challenge and an important field of interest from the economical point of view. Although many epidemiological studies on dental diseases in beagles bred under controlled conditions have been realized, information on frequency of these alterations in populations of pet dogs, especially in Central Europe, is far from complete. The aim of our study was to assess the prevalence of the most common oral diseases in dogs in a Czech urban region. A total number of 408 dogs, presented at a private Czech urban veterinary hospital for different reasons, were analyzed. Site specificity and severity of dental diseases were assessed using modified indexing systems. Dental alterations could be found in 348 out of 408 dogs (85.3%). The most frequent diseases were (i) periodontitis (60.0% of 408 dogs), (ii) calculus (61.3%), (iii) missing teeth (33.8%), and (iv) abnormal attrition (5.9%). Furthermore, single cases of caries, tumors and enamel hypoplasia could be observed. Periodontitis occurred preferentially in the upper jaw of small dogs and increased with age. The labial/buccal side of teeth was affected more severely than the lingual/palatinal side. Differences between left and right side could not be observed. Malocclusion and insufficient oral hygiene care seem to predispose to periodontitis. As periodontitis, dental calculus occurred preferentially in small dogs and increased with age. The prevalence of calculus formation did not differ between left and right side. However, the upper jaw showed a higher degree of affection than the mandible. On the labial/buccal side of the teeth, a thicker calculus layer could be observed than lingually/palatinally. Interestingly, the degree of calculus formation and of periodontitis did not correlate in all cases, supporting the hypothesis that supragingival calculus *per se* is not an irritant. The pattern of tooth loss was the same between left and right side and between upper and lower jaw. Most commonly, the first premolars were missing followed by incisors and other premolars and molars. Tooth loss for other reasons than periodontitis and single cases of tooth agenesis has not been detected in our study. (Abnormal) tooth wear was detected only in older dogs and affected mostly canines and premolars of large breeds. Age estimation based on dental attrition should be carried out with care, because tooth wear depends on keeping conditions and feeding of the dog. Our study confirmed the high prevalence of oral diseases in dogs. Veterinarians could improve the effectiveness of treatment concentrating their diagnostic efforts on age groups and types of teeth at highest risk, as assessed in this and other reports.

Keywords: periodontitis; periodontal disease; calculus; missing teeth; tooth loss; attrition; tooth wear; diagnosis

Oral disorders are of major clinical importance in the dog. From a survey made in the United States resulted that only 7% of the dog population can be considered healthy (Lund et al., 1999). Epidemiological studies have shown that periodontal disease and dental calculus are the most common oral diseases in the dog (Page and Schroeder, 1981; DeMeijer et al., 1991; Hoffmann and Gaengler, 1996; Harvey, 1998; Lund et al., 1999). Other important alterations are missing teeth, (abnormal) attrition, caries and tumors (Hale, 1998; Lund et al., 1999).

Periodontal disease is the predominant disorder of the oral cavity not only in dogs, but also in other animals (Page and Schroeder, 1982; Genco et al., 1998). They are mostly considered diet-related disorders (Krasse and Brill, 1960; Page and Schroeder, 1982; Genco et al., 1998; Gorrel, 1998; Harvey, 1998; Lund et al., 1999). A soft diet causes accumulation of bacterially colonized dental plaque. Periodontal inflammation is a process affecting the tissues surrounding the tooth. It is induced either experimentally or occurs spontaneously, and is correlated to the occurrence of gingival inflammation. The lack of oral hygiene causes plaque deposition and calculus formation, which harbors the bacteria and eventually induces gingival inflammation (Lindhe et al., 1975; Page and Schroeder, 1982). It has been suggested for a long time that these disorders are detrimental only to the oral cavity. However, recently showed some studies a close association of these disorders with the general health of the animal. The persistent infection of the oral cavity does not only discomfort the affected animal, but may also cause diseases of distant organs (DeBowes et al., 1996). Overt bacterial infections are seen only rarely, but the inflammatory response, which they elicit in the gingival tissue, is ultimately responsible for a progressive loss of collagen attachment of the tooth to the underlying alveolar bone. The consequence is the loosening or even loss of the tooth (Loesche and Grossman, 2001). While feeding soft diets has recently become very popular with dog owners, proper oral hygiene care (e.g., tooth brushing), which is proven to prevent effectively periodontal and other oral diseases, is rarely provided (Hamp and Loe, 1973; Lindhe et al., 1973; Hennet, 2002).

A decrease of tooth number in dogs can be caused by agenesis (mostly in small, brachycephalic breeds) or by tooth loss in consequence of periodontal disease or mechanical affection. Mostly are lost the lower third molar, upper and lower first premolar and the incisors, usually due to periodontal disease (Harvey et al., 1994). The lower first premolars are often missing in young dogs, usually due to agenesis (Harvey et al., 1994; Hoffmann and Gaengler, 1996).

Abnormal attrition is mostly observed in working dogs, in dogs fed a hard diet, in dogs that love to play with stones, and in so called "wire-biters" (Van Foreest and Roeters, 1998)

Dental caries is a rare disease compared to other dental disorders in the dog. The teeth most commonly involved are the last premolar and the first molar teeth (Hale, 1998).

Oral tumors account for six percent of all canine tumors. The most frequent oral tumor is the squamous cell carcinoma (20% of oral tumors), followed by fibrosarcoma (10%), and other oral neoplasms (Ramos-Vara et al., 2000)

Oral disorders in the dog represent for veterinarians both a medical challenge and an important field of interest from the economical point of view. Therefore, in dogs have been realized numerous studies on periodontal disease with large parameters (Heijl and Lindhe, 1980; Syed et al., 1980; Newes et al., 1997; Hennet, 1999). However, most of them deal with beagle dogs bred in controlled environment (Rosenberg et al., 1966; Saxe et al., 1967; Lindhe et al., 1975), whereas information on oral disorders in pets is far from complete. Site prevalence and severity of affections is assessed only rarely. Available extensive epidemiological studies concerning dental disorders in humans could serve as a model for such research in animals (Genco et al., 1998).

The purpose of this retrospective study was to document the prevalence of the most common oral diseases in dogs that were presented at a Czech urban veterinary hospital and to assess which teeth are preferentially affected. The results of this study should alert practitioners to the main oral problems of dogs and help to communicate with the clients/pet owners regarding these important disorders.

MATERIAL AND METHODS

Animals

This study was realized during the period of 2003–2004. A total number of 408 dogs, which had been presented at a private Czech urban veterinary hospital for different reasons, was analyzed for alterations of the oral cavity. The dogs were classified into groups according to their age (as reported by the owners): 1–4 years of age, 5–8 years of age, 9–11 years of age, 12–13 years of age; and according to their size: small breeds of less than 10 kg, medium sized breeds 10–30 kg, and large breeds of more than 30 kg body mass (Table 1). The standard tooth formula of the permanent dentition of the dog, which was used for determination of missing teeth and sites of other pathological changes of the dentition, is I3/3, C1/1, P4/4, M2/3 (Page and Schroeder, 1982).

Table 1. Age and size distribution of the examined dogs (number of the dogs)

Age groups	Small breeds	Medium breeds	Large breeds
1–4 years	67	66	14
5–8 years	49	53	21
9–11 years	43	42	15
12–13 years	22	9	7
Total number	181	170	57

Clinical examination and classification of oral disorders

Each dog was examined clinically. Number and localization of teeth, degree and localization of periodontal disease, dental calculus, dental wear (attrition), dental caries and any other alterations of the oral cavity were recorded.

Periodontal disease, formation of dental calculus and crown abrasion were scored according to a modified indexing system commonly used in the man.

In human dentistry, alterations of the periodontium are measured using the well accepted Silness and Loe plaque index (Loe and Silness, 1963), which is based on evaluation of plaque accumulation and gingival inflammation. This indexing system was used in this study with slight modifications as follows, (0) Healthy gingiva without signs of gingivitis, probing depth 0.0–1.0 mm; (1) Gingivitis with slight swelling and mucosa turning reddish, probing depth 0.0–1.0 mm; (2) Early periodontal disease with swelling and mucosa turning reddish, probing depth less than 2.5 mm; (3) Moderate periodontal

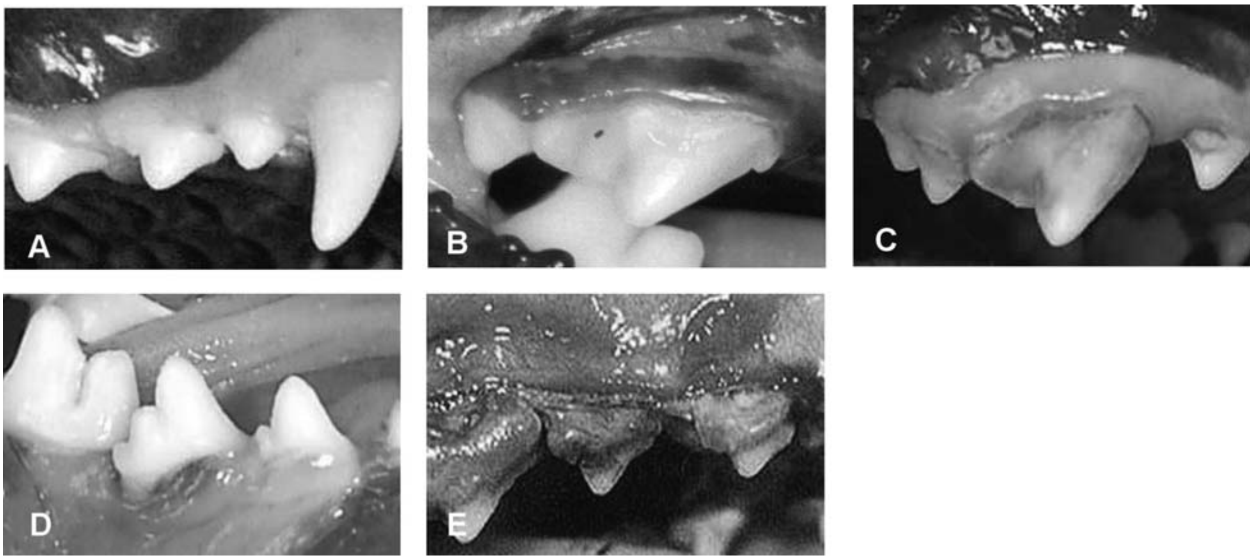

Figure 1. Stages of periodontal disease according to the Silness and Loe plaque index. (A) Stage 0, Healthy gingiva. Gingiva clinically not inflamed, firm, pale pink in color (unless pigmented), minimal dental deposits (plaque and calculus). No bleeding on gentle probing, probing depth 0.0–1.0 mm. (B) Stage 1, Gingivitis. Slight swelling of the gingiva, hyperemia, color of turning reddish. Slight bleeding on probing, probing depth 0.0–1.0 mm. (C) Stage 2, Early periodontitis. Gingiva swollen and red due to severe hyperemia. Teeth usually with dental deposits (redundant plaque and/or calculus). Bleeding on probing, probing depth 1.0–2.5 mm. (D) Stage 3, Moderate periodontitis. Inflamed gingiva, teeth with dental deposits. Bleeding on probing, probing depth up to 5.0 mm. The gingival margins begin to recede. (E) Stage 4, Severe periodontitis. Signs of clearly inflamed gingiva. Gingival recession results in visible root surfaces and furcation involvement. Probing depth either more than 5.0 mm or very low due to a receded gingiva

disease with swelling and red mucosa, often with hemorrhages, probing depth of less than 5.0 mm; (4) Severe periodontal disease with red and swollen mucosa, alveolar bone loss, probing depth more than 5.0 mm (Figure 1). The degree of gingival inflammation was examined separately for each tooth class region (e.g. incisor, premolar, molar region) and for labial/buccal and lingual/palatinal side.

Formation of dental calculus was examined and scored by a calculus indexing system (Greene and Vermillion, 1964) as follows, (0) No dental calculus; (1) Supragingival calculus covering less than one third of crown surface; (2) Supragingival calculus covering more than one third but less than two thirds of the dental crown; (3) Supragingival calculus covering more than two thirds of the dental crown. Dental calculus was examined separately on both labial/buccal and lingual/palatinal surfaces of the teeth.

Tooth crown abrasion was classified as follows, (0) No abrasion of the dental crown; (1) Abrasion of less than one third of the crown; (2) Abrasion of more than one third of the crown.

In addition, all dogs, if possible, were checked for history of dental treatment and its details.

RESULTS

A total of 348 out of 408 dogs (85.3%) presented to the small animal clinic showed dento-gingival alterations. In some but not all cases, these alterations were the reason why the owners did consult a veterinarian.

The following dental and gingival alterations could be observed: (i) periodontal disease (60.0% of 408 dogs), (ii) calculus (61.3% of 408 dogs), (iii) missing teeth (33.8% of 408 dogs), and (iv) abnor-

Table 2. Prevalence of dental disorders in pet dogs presented at a Czech urban veterinary hospital for different reasons in dependence on age and body size

Age groups	Prevalence of dental disorders (%)			
	Small breeds	Middle breeds	Large breeds	Total
Periodontal disease				
1–4 years	53.7	31.8	21.4	40.8
5–8 years	68.1	47.2	42.8	53.6
9–11 years	86.0	88.1	66.6	85.0
12–13 years	90.1	88.8	85.7	89.4
Dental calculus				
1–4 years	53.7	48.5	28.6	48.9
5–8 years	57.2	58.5	42.9	55.2
9–11 years	76.7	85.7	60.0	78.0
12–13 years	81.8	88.8	85.7	84.2
Missing teeth				
1–4 years	22.4	19.7	7.1	19.7
5–8 years	28.6	41.5	0.0	29.3
9–11 years	51.2	59.5	40.0	53.0
12–13 years	54.5	55.5	42.8	52.6
Dental attrition				
1–4 years	0.0	0.0	0.0	0.0
5–8 years	0.0	0.0	28.5	4.9
9–11 years	4.6	19.0	25.0	14.0
12–13 years	0.0	22.2	28.5	10.5

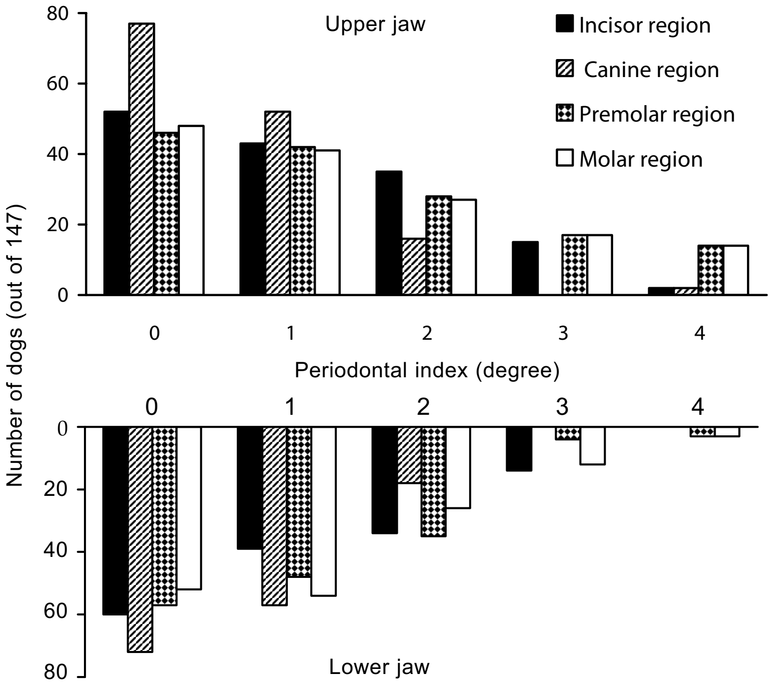

Figure 2. Prevalence and localization of periodontal disease in dogs (age group 1–4 years) assessed by a periodontal indexing system

mal attrition (5.9% of 408 dogs). The prevalence of these diseases depending on age and size of the dogs is shown in Table 2. Furthermore, there were single cases of dental caries, tumors and enamel hypoplasia. These cases were so rare that they were not further analyzed.

Alterations of the periodontium represented the most common oral disease in the dogs under study

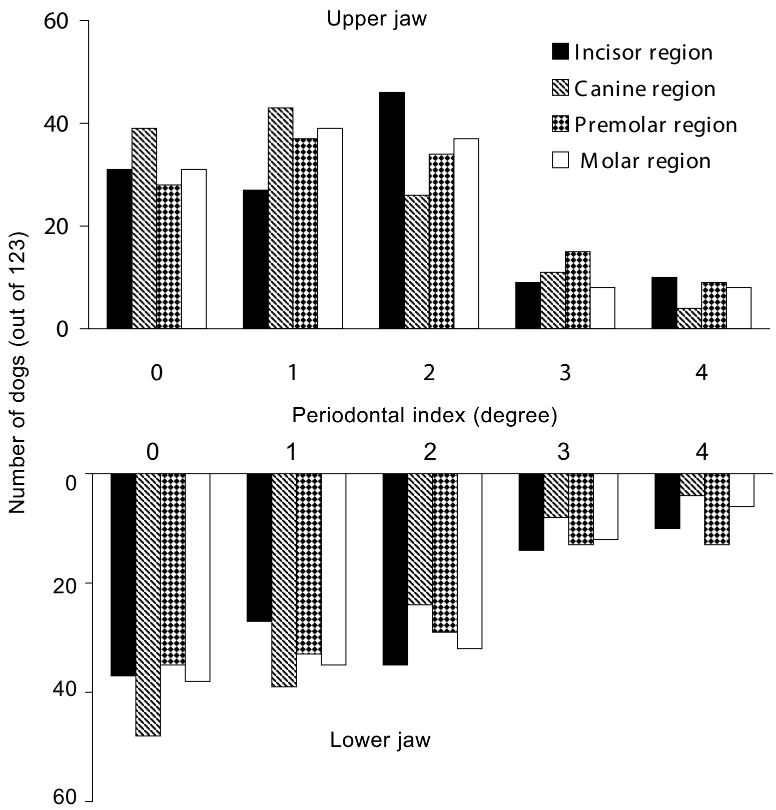

Figure 3. Prevalence and localization of periodontal disease in dogs (age group 5–8 years) assessed by a periodontal indexing system

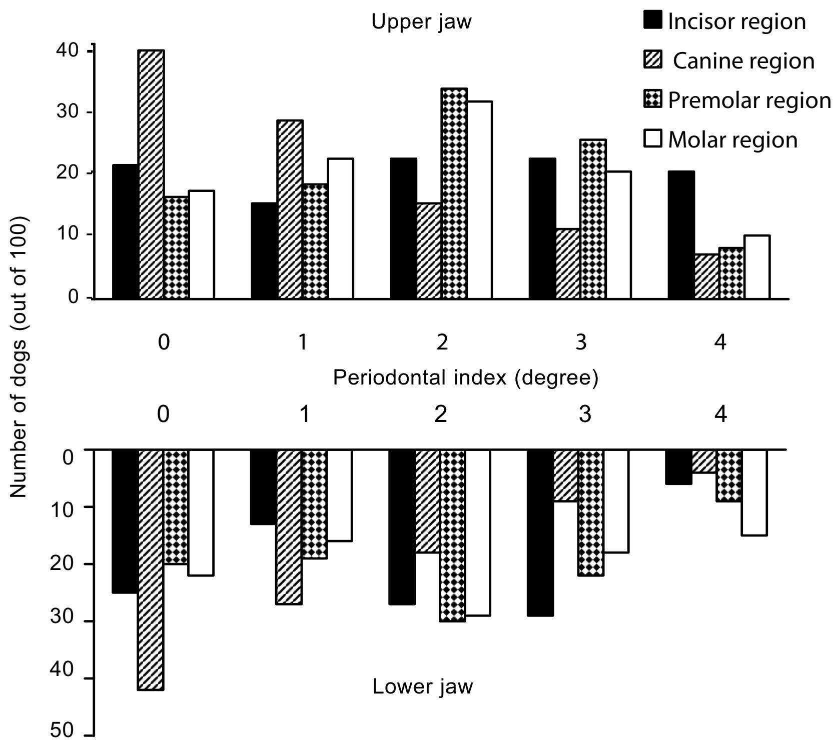

Figure 4. Prevalence and localization of periodontal disease in dogs (age group 9–11 years) assessed by a periodontal indexing system

where 245 out of 348 dogs with dento-gingival disorders were found to be positive. Differences between left and right jaw quadrant could not be observed. The frequency of periodontal alterations as well as the degree of inflammation increased with age. Earliest signs occurred first in small breed dogs.

Figure 1 shows typical features of gingival inflammation scored as degree (0), (1), (2), (3) and (4) in the examined dogs. The single degrees of periodontal disease were represented by increasingly swollen and reddish gingiva and deep gingival sulci, sometimes with soft deposits. Radiographs, which were made in some severe cases of periodontal disease, revealed in every case a certain degree of alveolar bone loss.

Assessment of the Silness and Loe index of periodontal disease revealed that the labial/buccal surface of the tooth was more affected than the lingual/palatinal surface. Periodontal alterations and gingival inflammation started mostly in the premolar region of both upper and lower jaw and spread with increasing age first to the molars and later to other regions of the jaws (Figures 2–5). Periodontal disease was more frequent and more severe in the upper jaw in comparison with the mandible (Figures 2–5).

Dental calculus in young age was observed mostly in small dogs. The degree of dental calculus increased with the age of the animal (Table 2). The prevalence of calculus formation did not differ between left and right side, however, it did differ between upper and lower jaws with a higher degree of affection of the upper jaw. Generally, on the labial/buccal side of the teeth, thicker calculus layers could be observed than lingually/palatinally.

The distribution pattern of dental calculus index was about the same between the left and right side and between upper and lower jaw. However, the dental calculus index was lower in large dogs compared to small dogs and increased with age.

Tooth loss increased with age (Table 2) and with increasing degree of gingival inflammation. The pattern of tooth loss was about the same between left and right side and between upper and lower jaw. The teeth most commonly missing were the first premolars followed by incisor teeth and then by other premolars and molars. Premolars followed by incisors were most often missing in small sized breeds. Medium sized breeds often lost premolar and molar teeth, in contrast to large sized breeds, where only premolar teeth were frequently missing. The sites of missing teeth correlated with the sites of periodontal disease. There were only single cases of tooth agenesis in young dogs.

Dental attrition was observed only in older dogs. Abrasion increased with age, in single cases reach-

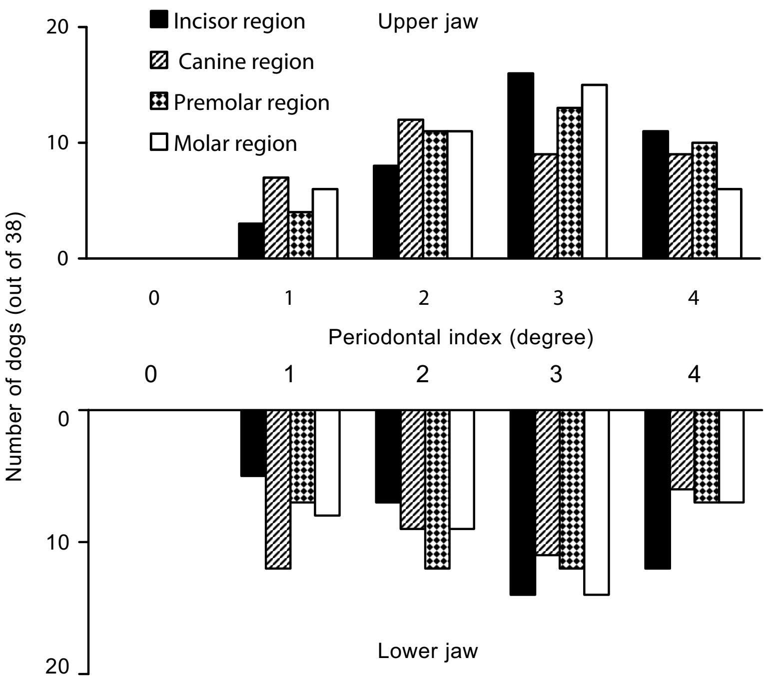

Figure 5. Prevalence and localization of periodontal disease in dogs (age group 12–13 years) assessed by a periodontal indexing system

ing degree 2 in dogs older than eight years of age. Large breeds were generally more affected than small and middle breeds (Table 2). Tooth wear did neither differ between left and right side nor between upper and lower jaw. Abrasion started in canines and premolars. These teeth were also most severely affected.

The percentage of dogs that had received home oral hygiene care was very low. It mostly consisted of daily tooth brushing using a tooth paste designed for animals and regular scaling of dental calculus by veterinary surgeons.

DISCUSSION

This study aimed to assess the prevalence of oral diseases of pet dogs in a Czech urban region. Periodontal disease, dental calculus and tooth loss were the most frequent alterations found in this study. Similar results were also reported by other authors (Lindhe et al., 1973; Page and Schroeder, 1982; DeMeijer et al., 1991; Harvey et al., 1994; Hoffmann and Gaengler, 1996; Genco et al., 1998; Gorrel, 1998; Harvey, 1998; Lund et al., 1999). Additionally, our study revealed few cases of other oral disorders such as oral tumors, enamel hypoplasia, tooth attrition and dental caries, which have also been described to be found in dog populations (DeMeijer et al., 1991; Lund et al., 1999).

Interestingly, recent studies (DeMeijer et al., 1991; Hoffmann and Gaengler, 1996; Harvey, 1998; Lund et al., 1999) reveal in general a higher prevalence of oral disorders in dogs compared to older studies, which concerned, however, mostly beagle colonies (e.g., Rosenberg et al., 1966; Saxe et al., 1967). This can be explained either as a result of increasing prevalence of these disorders or as a virtual increase, because veterinary clinicians are more often requested for dental treatments in dogs. It might be also a misinterpretation because of different approaches to epidemiological studies (Preshaw et al., 2004).

Periodontal disease seems to be one of the most common oral disorders in small animals (Gorrel, 1998). We observed an increasing prevalence and severity of periodontal disease with increasing age of the dogs. These findings are in agreement with previous experimental studies on beagle colonies (Rosenberg et al., 1966; Saxe et al., 1967) as well as with retrospective studies in pet dogs (Harvey et al., 1994; Hoffmann and Gaengler, 1996; Harvey, 1998; Lund et al., 1999). Interestingly, these studies revealed that the disease develops spontaneously in dogs fed with both homemade and commercial-type diet.

We observed a higher frequency and earlier onset of periodontal disease in small breed dogs compared to large breeds. This state could be explained by genetic predisposition, which render the gingiva more susceptible to periodontal disease. Also malocclusions, which are very common in small breeds, expose the teeth to deposition of subgingival plaque resulting in periodontal disease. Some reports show that all dogs older than 5 years of age suffer from some degree of periodontal disease (e.g., Hamp and Loe, 1973; Hoffmann and Gaengler, 1996).

The most often inflamed site of gingiva in dogs is apparently the premolar region followed by the molar and then the incisor region. The labial/buccal gingiva is more affected than the lingual/palatinal gingiva. In contrast to the dog, the molar region is most predilected for periodontal disease in the human (Loesche and Grossman, 2001; Newman and Carranza, 2002), probably because it is difficult to remove plaque by simple brushing in this region (Newman and Carranza, 2002). Dogs usually do not receive oral hygienic treatment.

According to our study, the gingiva seems to be more often inflamed in the upper jaw than in the mandible. These results are, however, in contradiction with most other reports (Hamp and Loe, 1973; Harvey et al., 1994; Hoffmann and Gaengler, 1996) indicating the same prevalence in both areas.

Development of periodontal disease varies at different sites. The same dentition may show both normal sites and sites with gingivitis and periodontal disease. For planning and evaluation of the effect of treatment, diagnosis should be therefore site specific (Harris, 2003). In our study, there were no differences between right and left side, but between the individual tooth regions. The sites of most severe affection differed in dependence on the animal group.

Simple periodontal disease indicators (scores) allowing to choose appropriate treatment methods and to predict clinical outcome, which are suitable for the screening of large animal populations, are still lacking (Harvey et al., 1994). Whether indexes adapted from human medicine (e.g., Loe and Silness, 1963) will be helpful remains to be tested. Biopsy of apparently diseased tissue followed by histological examination might be useful as an additional diagnostic tool (Johnson et al., 1988).

Accumulation of dental calculus increases, similarly as periodontal disease, with the age of the animal. Our study revealed that dental calculus appeared in some small breed dogs as early as at one year of age. These dogs had persistent deciduous teeth, which caused malocclusion and thus created an optimal surface for plaque accumulation. According to Rosenberg et al. (1966), the pattern of calculus formation matches the inflammation status of the periodontal tissue. These authors observed that about 95% of pet dogs fed either a homemade or commercial type diet show heavy calculus deposition at the age of 26 months and that the gingival inflammation becomes more severe with increasing age. However, calculus itself does not seem to be an irritant. In fact, it has been shown that under certain conditions a normal attachment may be seen between the junctional epithelium of the gingiva and calculus (Fitzgerald and McDaniel, 1960). Autoclaved calculus can be encapsulated in connective tissue without causing marked inflammation (Allen and Kerr, 1965). Our study supports this information, since thick calculus deposits have been found in many examined dogs with only a light degree of gingival inflammation. Apparently, supragingival calculus *per se* is not directly involved in the etiology or even pathogenesis of periodontal disease and is mainly of cosmetic significance if plaque is not too large (Lang et al., 1997). However, plaque can be indirectly responsible for gingival inflammation as a result of the immune response of the host (Bascones et al., 2004).

Loosening of teeth and following tooth loss is often elicited by inflammatory response in the gingival tissue, which leads to a progressive loss of collagen attachment of the tooth to the underlying alveolar bone (Loesche and Grossmann, 2001). Our study revealed a relatively large number of missing teeth in the examined dogs. The sites of missing teeth agreed with other reports (Page and Schroeder, 1981): the first premolars; then the other premolars and incisors, and finally molars ensuing. Interestingly, the sites of marked periodontal disease were similar to those of missing teeth. The number of missing teeth increased with the progression of periodontal inflammation and with age, suggesting a causal relationship between these two alterations (Page and Schroeder, 1982). Tooth loss for other reasons than periodontal disease or tooth agenesis has not been detected in our study. Some studies present also other causes of missing teeth, such as traumatic tooth loss (Bittegeko et al., 1995; Dole and Spurgeon, 1998).

Attrition of teeth becomes apparent in older dogs (older than eight years of age). The age of dogs can be estimated based on the degree of dental attrition. This method is, however, highly speculative, because tooth wear depends on feed and keeping conditions (Berglundh et al., 1991).

In agreement with a previous report (Hoffmann and Gaengler, 1996), our study revealed no dental caries in the examined dogs. The scarcity of dental caries contrasts with the high prevalence of periodontal disease and calculus formation. The reason is unexplained at present. It is speculated that the oral condition of the dog including the oral bacterial flora may be suitable rather for the development of periodontal disease than for dental caries formation (Gorrel, 1998; Hale, 1998). The anatomical conformation of the tooth crown and the thicker layer of enamel compared to human teeth could be another reason. However, there is no evidence to support this assumption so far.

Our study as well as many others showed the high prevalence of oral diseases in dogs and confirmed that periodontal disease is the most common oral condition in dogs. It is well known from human studies that a majority of dental disorders can be prevented by daily oral hygiene. Periodontal disease is almost always significantly associated with the overgrowth of bacteria in the subgingival plaque. This overgrowth can be periodically suppressed by mechanical periodontal debridement. The oral flora can also be altered by the judicious use of antimicrobial agents (Loesche and Grossman, 2001). Appropriate instructions concerning dental hygiene to the pet owners should be helpful to lower the incidence of dental disorders in a dog population. Clinicians could also improve the effectiveness of treatment concentrating their diagnostic efforts on age groups and types of teeth at highest risk, as assessed in this and other reports. Follow-up studies will be necessary to test the effectiveness of pet owner education, training and alerting of veterinarians and improved dental hygiene care in a given dog population.

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