Periodontal bone loss in the aging beagle dog
A radiographic study


Abstract. Studies in the beagle dog have clearly established the usefulness of this breed in periodontal disease research. However, little is known about the progressive nature of the disease with advancing age. It is the purpose of this paper to describe frequency and distribution of radiographically detectable lesions in an aging population of 166 colony dogs. 3 grades of alveolar bone loss were determined on high-quality postmortem radiographs. The number of teeth involved was similar in male and female and was age-dependent. Disease was more frequent in the maxillary arcades, with the 2nd upper premolar most frequently involved. Most extensive bone loss was noted around the 3rd and 4th upper premolars, and 1st and 2nd lower molars. It is felt that by the study of such a large group of older colony dogs, a better understanding can be gained of the expected alveolar bone loss with age as determined radiographically.

Studies in the beagle dog of experimentally produced as well as spontaneously occurring gingivitis, which gradually develop from a subclinical gingivitis to a clinical gingivitis and periodontal disease, have increased knowledge of the pathogenesis of periodontal disease in humans. These studies have clearly established the usefulness of this breed in periodontal research (Rehfeld et al. 1958, Rehfeld & Sorenson 1960, Rosenberg & Emmering 1962, Rosenberg et al. 1963, 1964, 1966, Rosenberg 1967, Saxe et al. 1967, Gad 1968, Lindhe et al. 1973, 1975, Hull et al. 1974). An additional study has used other breeds of dogs with similar findings (Hamp & Lindberg 1977). Others have shown minimal differences between the pathogenesis of the early disease as well as more prominent vascular proliferation and lack of fibrosis in the dog (Page & Schroeder 1981). Most studies have reported a high incidence of periodontal disease in beagle dogs; however, there is limited information on the progressive loss of alveolar bone architecture with advancing age. The oldest dogs previously studied are 12 years of age (Rosenberg & Emmering 1962, Sorenson et al. 1980).

From epidemiological studies, it may be concluded that the etiological factors of periodontal disease in dogs are similar to those in man (Theilade 1960, Løe & Silness 1963, Rosenberg et al. 1966, Saxe et al. 1967, Lindhe et al. 1973, Hull et al. 1974). Grove (1982) supported the idea that the development of periodontal disease in beagle dogs depends more on local periodontal irritation than on nutritional adequacy of the diet. In addition, periodontal disease in beagle dogs may not occur or progress with equal severity in all areas of the mouth with age (Grove 1982).

Radiographic determination of bone loss has not been used frequently in these studies in the dog (Collings & Redden 1959, Hamp & Lindberg 1977). It has been suggested that, "if the Beagle is to continue to be used widely as a model, a thorough study of the prevalence of chronic periodontitis is warranted" (Page & Schroeder 1981). It is the purpose of this report to describe frequency and distribution of radiographically detectable bone loss in a large aging population of Beagle dogs.

Material and Methods
A total of 166 beagle dogs were studied at time of natural death, of which 122 were females and 44 were males. The dogs were divided into 3 groups: an older male control group of 44 dogs (8.1 to 18.0 years) with a mean age and standard deviation (SD) at death of 15.1 years (SD± 2.21), an older female control group of 39 dogs (7.3 to 17.6 years) with a mean age and standard deviation at death of 14.0 years (SD± 1.84), and a middle-aged group of 83 females from the breeding colony (7.9 to 13.9 years) with a mean age and standard deviation at death of 11.1 years (SD± 1.36).

The dogs were from a closed colony and had served either as the control group or as the breeding colony for a toxicity study. The dogs were penned throughout their lives and lived in 5×3 m wire enclosures, sleeping in bars raised 25 cm above the ground. All dogs were fed a constant diet throughout their lives (Wolf et al. 1966, Wolf 1973). All dogs received life-long medical treatment that included dental examination.
Dental treatment was limited to periodic prophylactic cleaning and extraction of diseased teeth.

At death, high-detail lateral radiographs were made of the 4 dental arcades. The character of incisor teeth and surrounding alveolar bone was only partially evaluated on the radiographs, and thus only a description of the canine, premolar, and molar periodontal tissues is included in this study.

The determination of periodontal bone loss was based on radiographically determined regression of the alveolar crest. A distance from the cemento-enamel junction (CEJ) to the depth of the radiographically determined defect was assigned a grade of 1 for 1 to 2 mm regression, a grade of 2 for 2 to 5 mm regression, and a grade of 3 if the regression was greater than 5 mm. A < 1 mm distance from the CEJ to the alveolar crest was considered to be normal. It was possible to detect furcation lesions in addition to those mesial and distal. Mesial and/or distal bone loss was often noted without furcation involvement. This will be the subject of a separate report. In a tooth with multiple roots, the most severe vertical alveolar bone destruction was measured and recorded as indicative of regression for that tooth (Figs. 1, 2).

**Results**

The frequency and severity of the radiographically detected periodontal bone loss were determined and recorded as percentages in teeth present at the time of death (Figs. 3–6).

Alveolar bone loss of all grades around canine, premolar, and molar teeth involved 5.3 teeth per dog in the older male control group, 6.1 teeth per dog in the older female control group, and 4.7 teeth per dog in the younger female breeding colony. Alveolar bone loss involved more teeth in the maxillary arch (586) than in the mandibular arch (277). Involvement of right (446) and left (417) sides was similar. Of those teeth with disease, grade 1 was noted in the younger female group (62%) as...

*Fig. 1.* High-detail postmortem radiographs of the maxillary dental arcades, showing extensive alveolar bone regression (arrows). (A) 14.9 year male, left arcade; (B) 15.2 year male, right arcade; (C) 12.7 year male, right arcade; (D) 11.5 year male, left arcade; (E) 13.4 year female, right arcade.
compared to the older male (38%) and female groups (39%), indicating less severe disease in the younger female dogs. Additionally, of those teeth with disease that were graded 1, the frequency in the maxillary teeth (54%) was greater than in the mandibular teeth (37%), indicating less severe disease in the maxillary arch.

Radiographically determined bone loss was not equally present around all teeth. Greatest involvement was noted in the first 3 upper premolars (47%). This was compared with lesser involvement in the 4 lower premolars (14%). Disease was uncommonly found in the 2 upper molars (3%) as compared with the 3 lower molars (15%). The upper canine teeth were more frequently involved (26%) than the lower canine teeth (2%). The individual tooth with the greatest frequency of involvement was the 2nd upper premolar, with 55% of these teeth showing alveolar bone loss.

The degree of periodontal bone loss was progressive, with 50% of affected teeth recorded as grades 2 or 3. Progression was highest in certain teeth. If diseased, grades of 2 or 3 were recorded for 60% of the 4th upper premolar, 70% of the 2nd lower molar, and 80% of the 1st lower molar.

Discussion

This report presents cross-sectional data concerning radiographically determined alveolar bone loss in a larger and older group of beagle dogs than has been previously reported. Because the study was limited to changes determined from postmortem high-detail radiographs, it was not possible to determine the frequency or involvement of gingivitis, depth of attachment level, and it was not possible to determine gingival regression or soft tissue pocket formation. Also, the amount of plaque and calculus accumulated on the teeth was not evaluated.

Errors in radiographic evaluation have been reported in humans (Theilade 1960, Hollender et al. 1966). They suggested that determination of a well-defined point to represent the CEJ, as seen radiographically, is difficult. Therefore, the measurement from the CEJ to the alveolar crest is inaccurate. This was partially overcome in this report through the use of large ranges of measurement which determined the 3 study groups.
All dogs were on an acceptable diet (Wolf et al. 1966, Wolf 1973) throughout life, partially eliminating this as an influencing factor in the frequency of periodontal disease noted. It has been suggested that periodontal disease in beagle dogs depends more on local periodontal irritation than on the nutritional adequacy of the diet (Grove 1982). Others have implicated a soft diet as causing earlier and more rapidly developing periodontal disease in dogs (Egelberg 1965a, 1965b). Oxtails were fed for a 2-year period during the lives of the dogs, possibly providing some control of calculus accumulation and gingival inflammation (Anderson 1965).

High levels of medical care received by the dogs may have played an important role in the degree of periodontal disease. Prophylactic dental treatment was administered during the early years of their lives; however, with advancing age, anesthesia was considered dangerous, and no preventative dental treatment was performed. It is of interest that no radiographically detected bone loss was noted in several beagle dogs aged 17 years. The dogs were bred and maintained under standardized conditions, and it is tempting to speculate that the minimal degree of bone loss may have been influenced by the high quality of the diet, prophylactic dental care, ready availability of medical care, or possibly a genetic influence. Identification of these factors requires further study.

This study supports earlier reports suggesting that periodontal disease does not occur with equal severity in all areas of the mouth (Sorensen et al. 1980, Page & Schroeder 1981). The pattern of disease in this study is generally similar to earlier reports, with the upper premolars most frequently involved. One report noted that calculus scores, plaque scores, attachment loss, and pocket formation were often found involving the 4th upper premolar, 1st upper molar, and 4th lower premolar (Sorensen et al. 1980). In this study, alveolar bone regression around these 3 teeth was noted to a lesser degree. In our experience, the distribution of radiographically determined bone loss corresponds to the pattern of gingivitis and deep periodontal pockets seen in a general clinic population.

In this study, the upper canines were often involved, but to a lesser degree than the first 3 upper premolars. The lower canines were rarely affected. This finding contradicts an earlier study which described the almost complete absence of bone loss around the canine teeth (Page & Schroeder 1981), exemplifying the difficulty in comparing a purely radiographic study with one using clinical examination as the technique used to determine the presence of disease. The pattern of bilateral symmetry noted in this study has been previously described in the Beagle dog (Page & Schroeder 1981).

The 3 groups of dogs consisted of a male population, a female population without pregnancies, and a female population that had frequent pregnancies with differences in severity of alveolar bone loss most likely due to age. On examination of the severity of the alveolar bone loss between the 3 groups and the similar distribution of the lesions, it is suggested that prevalence and severity of periodontal bone loss was not influenced by sex or by pregnancy, as had been suggested earlier (Löe & Silness 1963, Silness & Löe 1964).

Résumé

Perte osseuse parodontale chez le chien Beagle vieillissant: étude radiographique
Les études pratiquées chez le chien Beagle ont nettement montré l’utilité de cette race dans la recherche sur les maladies parodontales. Cependant, il n’existe que peu de connaissances sur la nature progressive de cette maladie lors du vieillissement. Le but du présent travail est de décrire la fréquence et la distribution des lésions que l’on peut discernner sur les radiographies dans une population vieillissante composée de 166 chiens d’un même colonie. La perte osseuse alvéolaire constatée sur les radiographies post-mortem de haute qualité a été classée en 3 degrés. Le nombre des dents atteintes était sensiblement le même chez les mâles et chez les femelles, et dépendait de l’âge. La fréquence de la maladie était plus élevée dans les mâchoires supérieures, le plus souvent au niveau de la 2ème prémolaire. La perte osseuse la plus étendue était constatée autour de la 3ème et de la 4ème prémolaire supérieure et de la 1ère et de la 2ème molaire inférieure. Il semble que l’étude d’un groupe de ce genre, composé d’un grand nombre de chiens d’une colonie, ayant atteint un âge avancé, permette de mieux comprendre la perte osseuse alvéolaire qui se manifestera sur les radiographies avec le vieillissement.

References


Address:
Joe P. Morgan
Department of Radiological Sciences
School of Veterinary Medicine
University of California
Davis, CA 95616
USA