

# Periodontal disease in the beagle dog

## A cross sectional clinical study

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A cross sectional study was done in seventy-four beagle dogs from one to twelve years of age. Gingivitis, calculus, plaque, loss of attachment, pocket depth and width of keratinized gingiva were scored and descriptive statistics calculated.

Gingivitis differed very little in the maxillary and mandibular incisor and canine regions at differing ages, while it was more severe on the buccal gingiva of premolars and first molars. Calculus scores were highest on the buccal surface of the maxillary P4 followed by the buccal surfaces of the maxillary M1 and mandibular P4. Plaque scores were high for the very young dogs and showed only slightly to moderately higher values with increasing age. The buccal surface of the maxillary P4 had the highest plaque score, followed closely by the buccal surfaces of the maxillary M1 and mandibular P4. Plaque scores were low in the incisor regions and on the lingual surfaces. On the buccal surfaces plaque scores increased from the C to P4, and then decreased in the molar regions.

Loss of attachment was minimal for anterior teeth and was greater in the premolar and maxillary M1 regions with older age. The greatest loss occurred on the distal surface of the maxillary P4, the mesial surface of maxillary M1, and distal surface of mandibular P4. The greatest difference existed between younger dogs and those older than six to seven years. Greater pocket depths were not generally proportionate to the greater loss of attachment, since recession accompanied loss of attachment. Pocket formation was found most often at the distal surface of the mandibular P4 in dogs six to seven years of age. The width of keratinized gingiva varied only slightly and inconsistently with age, except that slightly narrower widths were found at six to seven years of age.

Periodontal disease in the beagle dog occurred in specific areas with a high plaque accumulation in young dogs and more gingivitis, calculus formation, and loss of attachment in older animals.

*(Accepted for publication April 30, 1979)*

### Introduction

The beagle dog is becoming a useful animal in periodontal research. Cross sectional (Gad 1968, Rehfeld, Fisher & Nielson 1958, Rehfeld & Sorenson 1960, Rosenberg 1967, Rosenberg & Emmering 1962, Rosenberg, Emmering & Rehfeld 1963, 1964, 1966) and longitudinal (Saxe et al. 1965, 1967,

Lindhe, Hamp & Löe 1973, 1975) studies have reported a high incidence of periodontal disease in beagle dogs and dogs in general. The disease has been shown to be progressive with age. Correlations between gingival inflammation and local factors have been reported in beagles and other dogs (Gad 1968, Saxe et al. 1965, 1967). However, there is little detailed information

available on the progressive loss of attachment and pocket formation, or the presence of local factors with regards to specific tooth surfaces and age in the beagle dog (Rosenberg & Emmering 1962).

The purpose of the present study was to investigate the prevalence and severity of periodontal disease in the beagle dog from one to twelve years of age.

### Materials and Methods

#### *Beagle Dog Sample*

The beagle dogs used in this survey were part of a closed colony at Laboratory Research Enterprises, Inc., 6251 South Sixth Street, Kalamazoo, Michigan 49001. All dogs at the colony were checked routinely by a qualified staff of technicians and veterinarians, using standardized tests for local and systemic diseases and abnormalities. All dogs were fed a dry coarse diet, which is uniformly changed (regarding brand name) for the whole group. The dogs were not provided with any chewing blocks or devices. The dogs received food and water *ad libitum*, and were usually housed in pairs in standardized cages.

Sample selection and randomization were done by personnel at Laboratory Research Enterprises, Inc. (LRE). Originally, 117 anestrous bitches with reproductive histories were selected for possible use in the study. In order to equalize the sample size for each age group a total of 74 dogs were selected for the study. Age divisions were from greater than one year up to two years, greater than two years up to three years, etc., up to greater than twelve years of age. There were 12 dogs in age groups > 1-2, > 2-3, > 4-5, and > 5-6 years. Age group > 3-4 years had 11 dogs, age group > 6-7 years had 6 dogs, while the remaining age groups had only scattered representation.

It was assured by the personnel at LRE that the sample dogs had not received any,

or only minimal palliative dental care. On routine physical examinations it is the practice to remove a tooth if it is in a severely deteriorated state. It was assured, however, that this was rare. On some dogs, gross supragingival calculus had been removed once during routine physical examinations in 1971 and 1972.

In addition to the sample for the study, two samples of seven dogs each were selected for scoring standardization procedures. These were dogs that were culled from the colony because of poor or negative breeding histories or because of medical reasons.

#### *Examinations*

Examinations were carried out in a small surgery room at the facilities of LRE. All dogs were anesthetized for the examination procedures. The dogs were supported in a supine position in a "V" shaped cradle. The mouth was kept open with a McKesson Prop No. 876 on the side opposite that being examined.

The following instruments were used: Kerr # 5 front surface mirror, Type M1 probe from Marquis Dental Manufacturing Co., S. S. White Bunting # 5 and # 6 scalers, Miltex # 1 sickle, S. S. White explorers # 3, and Clevent # 17 explorer. Gauze squares, cotton swabs, and Bismark brown disclosing solution were used.

#### *Use of Indices and Sequence of Scoring*

All scoring was done by the same examiner. The present study was limited to teeth mesial to the second molars for reasons of access and visibility for thorough examination. Scoring was always started on the maxillary right side of the mouth, buccally and lingually from the posterior teeth anteriorly to the midline, followed by mandibular right quadrant. Gingivitis was scored first according to the periodontal disease index (PDI) (Ramfjord 1967). The

**Table 1**  
Gingivitis scores for buccal and lingual tooth surfaces (B,L)  
(mean scores  $\pm$  standard error)

AGE (MO)		Maxilla					
		18.2 $\pm$ .19	31.9 $\pm$ .14	43.6 $\pm$ .24	55.2 $\pm$ .14	67.2 $\pm$ .14	79.2 $\pm$ .32
I <sub>1</sub>	B	1.42 $\pm$ .18	1.42 $\pm$ .22	1.64 $\pm$ .14	1.25 $\pm$ .32	1.25 $\pm$ .18	1.83 $\pm$ .11
	L	1.42 $\pm$ .17	1.29 $\pm$ .13	1.32 $\pm$ .18	1.42 $\pm$ .15	.92 $\pm$ .19	1.83 $\pm$ .11
C	B	1.88 $\pm$ .09	1.92 $\pm$ .06	2.00	1.92 $\pm$ .10	1.92 $\pm$ .15	2.17 $\pm$ .11
	L	1.50 $\pm$ .15	1.50 $\pm$ .18	1.82 $\pm$ .10	1.46 $\pm$ .17	1.67 $\pm$ .13	2.25 $\pm$ .17
P <sub>2</sub>	B	1.58 $\pm$ .14	1.72 $\pm$ .12	2.15 $\pm$ .21	1.77 $\pm$ .14	2.14 $\pm$ .12	2.80 $\pm$ .20
	L	1.08 $\pm$ .19	1.23 $\pm$ .18	1.65 $\pm$ .17	1.27 $\pm$ .22	1.68 $\pm$ .18	2.40 $\pm$ .24
P <sub>4</sub>	B	2.13 $\pm$ .07	2.21 $\pm$ .10	2.14 $\pm$ .07	2.21 $\pm$ .14	2.46 $\pm$ .11	2.67 $\pm$ .21
	L	.83 $\pm$ .11	.75 $\pm$ .13	.91 $\pm$ .09	.96 $\pm$ .11	1.21 $\pm$ .14	2.00 $\pm$ .22
M <sub>1</sub>	B	1.79 $\pm$ .10	1.79 $\pm$ .11	1.86 $\pm$ .12	1.92 $\pm$ .16	2.25 $\pm$ .13	2.67 $\pm$ .21
	L	.38 $\pm$ .13	.25 $\pm$ .11	.55 $\pm$ .14	.46 $\pm$ .13	.75 $\pm$ .12	1.25 $\pm$ .21
		Mandible					
I <sub>2</sub>	B	.88 $\pm$ .21	.71 $\pm$ .18	1.36 $\pm$ .24	.63 $\pm$ .24	.50 $\pm$ .15	.83 $\pm$ .25
	L	.79 $\pm$ .16	.92 $\pm$ .19	1.50 $\pm$ .24	.79 $\pm$ .19	1.00 $\pm$ .17	1.17 $\pm$ .28
C	B	1.29 $\pm$ .13	1.50 $\pm$ .14	1.68 $\pm$ .12	1.54 $\pm$ .13	1.58 $\pm$ .17	1.92 $\pm$ .08
	L	1.17 $\pm$ .13	1.04 $\pm$ .17	1.41 $\pm$ .15	1.13 $\pm$ .13	1.42 $\pm$ .14	1.58 $\pm$ .24
P <sub>2</sub>	B	1.33 $\pm$ .17	1.67 $\pm$ .13	1.90 $\pm$ .23	1.80 $\pm$ .19	2.13 $\pm$ .11	2.33 $\pm$ .33
	L	1.63 $\pm$ .13	1.46 $\pm$ .16	1.75 $\pm$ .11	1.65 $\pm$ .24	2.00 $\pm$ .15	2.17 $\pm$ .44
P <sub>4</sub>	B	1.71 $\pm$ .11	1.59 $\pm$ .15	1.90 $\pm$ .19	1.94 $\pm$ .24	2.27 $\pm$ .16	2.80 $\pm$ .20
	L	1.50 $\pm$ .12	1.18 $\pm$ .19	1.40 $\pm$ .15	1.44 $\pm$ .19	1.45 $\pm$ .14	2.20 $\pm$ .25
M <sub>1</sub>	B	1.67 $\pm$ .11	1.33 $\pm$ .17	1.73 $\pm$ .16	1.04 $\pm$ .16	1.38 $\pm$ .14	1.67 $\pm$ .25
	L	1.38 $\pm$ .13	.92 $\pm$ .17	1.23 $\pm$ .14	1.08 $\pm$ .23	1.21 $\pm$ .11	1.67 $\pm$ .21

gingiva was dried superficially before scoring with a gentle blotting with gauze sponges when necessary. Calculus (Ramfjord 1967) was scored on the same teeth in the same order with separate scores for the buccal and lingual surfaces.

The width in millimeters of the keratinized gingiva was measured from the free gingival margin to the mucogingival line using the M1 probe. Measurements were made on the mid-buccal aspect of the maxillary and mandibular teeth and on the mid-lingual aspect of the mandibular first molar through the first premolar. The mandibular lingual measurements were limited, because of the anterior floor of the mouth consists of a pad of dense tissue similar to the palate in texture. Measurements were made to the

nearest millimeter, rounding off to the lower figure where question existed.

When the above scoring was completed on the right side, the head was rotated and the left side scored in the same manner. Then plaque was scored on the buccal and lingual surfaces according to Rosenberg's modification (Rosenberg & Ash 1974) of the Kobayashi and Ash technique (Kobayashi & Ash 1964).

After plaque scoring, pocket depth measurements were related to the cemento-enamel junction (CEJ) as recommended in the PDI (Ramfjord 1967). The order of sequence for measurements was the same as for the other indices. Measurements were made on the distal buccal, mid-buccal, mesial buccal, and mid-lingual aspects of

**Table 2**  
 Calculus scores for buccal and lingual tooth surfaces (B,L)  
 (mean scores  $\pm$  standard error)

AGE (MO)		Maxilla					
		18.2 $\pm$ .19	31.9 $\pm$ .14	43.6 $\pm$ .24	55.2 $\pm$ .14	67.2 $\pm$ .14	79.2 $\pm$ .32
I <sub>2</sub>	B	.54 $\pm$ .14	.75 $\pm$ .13	.91 $\pm$ .09	.71 $\pm$ .17	.46 $\pm$ .16	1.00 $\pm$ .26
	L	.13 $\pm$ .09	.29 $\pm$ .13	.36 $\pm$ .15	.33 $\pm$ .20	.29 $\pm$ .14	.83 $\pm$ .33
C	B	.96 $\pm$ .10	1.17 $\pm$ .11	1.09 $\pm$ .09	1.17 $\pm$ .09	1.29 $\pm$ .16	1.33 $\pm$ .25
	L	.42 $\pm$ .19	1.08 $\pm$ .21	1.09 $\pm$ .22	.75 $\pm$ .13	1.38 $\pm$ .21	1.58 $\pm$ .40
P <sub>2</sub>	B	.75 $\pm$ .12	1.14 $\pm$ .14	1.45 $\pm$ .16	1.27 $\pm$ .12	1.36 $\pm$ .19	2.20 $\pm$ .37
	L	.83 $\pm$ .24	1.36 $\pm$ .19	1.40 $\pm$ .16	.73 $\pm$ .23	1.64 $\pm$ .17	1.90 $\pm$ .40
P <sub>4</sub>	B	1.33 $\pm$ .18	2.17 $\pm$ .23	1.95 $\pm$ .16	1.96 $\pm$ .20	2.29 $\pm$ .22	2.42 $\pm$ .20
	L	.04 $\pm$ .04	.04 $\pm$ .04	.41 $\pm$ .18	.63 $\pm$ .18	.71 $\pm$ .23	1.33 $\pm$ .36
M <sub>1</sub>	B	1.04 $\pm$ .04	1.38 $\pm$ .14	1.59 $\pm$ .13	1.54 $\pm$ .20	1.96 $\pm$ .19	2.25 $\pm$ .17
	L	0.	0.	.18 $\pm$ .10	0.	.5 $\pm$ .26	.92 $\pm$ .45
		Mandible					
I <sub>2</sub>	B	.29 $\pm$ .18	.50 $\pm$ .16	.73 $\pm$ .19	.21 $\pm$ .11	.17 $\pm$ .07	.08 $\pm$ .08
	L	.21 $\pm$ .17	.54 $\pm$ .13	.45 $\pm$ .14	.42 $\pm$ .14	.46 $\pm$ .11	.33 $\pm$ .21
C	B	.38 $\pm$ .14	.83 $\pm$ .20	1.05 $\pm$ .11	.88 $\pm$ .90	.83 $\pm$ .13	1.17 $\pm$ .11
	L	.08 $\pm$ .06	.46 $\pm$ .11	.59 $\pm$ .11	.46 $\pm$ .13	.54 $\pm$ .13	.75 $\pm$ .25
P <sub>2</sub>	B	.79 $\pm$ .11	.92 $\pm$ .06	1.25 $\pm$ .13	1.10 $\pm$ .26	1.25 $\pm$ .22	2.00 $\pm$ .58
	L	.58 $\pm$ .14	.96 $\pm$ .04	1.15 $\pm$ .17	1.15 $\pm$ .26	1.33 $\pm$ .22	1.83 $\pm$ .60
P <sub>4</sub>	B	1.00 $\pm$ .12	1.22 $\pm$ .14	1.30 $\pm$ .26	1.61 $\pm$ .22	1.36 $\pm$ .15	2.30 $\pm$ .37
	L	.54 $\pm$ .14	.86 $\pm$ .23	.80 $\pm$ .13	1.33 $\pm$ .24	1.14 $\pm$ .15	2.00 $\pm$ .27
M <sub>1</sub>	B	.79 $\pm$ .20	1.13 $\pm$ .21	1.45 $\pm$ .16	1.17 $\pm$ .09	1.08 $\pm$ .21	1.08 $\pm$ .33
	L	0.	.29 $\pm$ .18	.41 $\pm$ .20	.42 $\pm$ .18	.42 $\pm$ .18	1.00 $\pm$ .45

the teeth. Measurements were done with the M1 probe parallel to the occlusal-apical axis of the tooth and touching the tooth to be measured and the adjacent tooth. When there was not an adjacent tooth, the line angle of the tooth was used as the anterior-posterior determinate for the measurement site. When a definite line angle was not present, the most anterior or posterior portion of the convex open interproximal surface was measured. Often the buccal and lingual furcations were exposed. The mid-buccal and mid-lingual measurements were then composed of the average of measurements along the axis of the distal surface of the mesial root and the mesial surface of the distal root. It was necessary

in many instances to dislodge heavy calculus for access and to locate the CEJ.

*Standardization Procedures*

Reproducibility in scoring was tested near the beginning and the end of the study. Two samples of seven dogs each were scored with the same indices and methods as the sample dogs. The dogs were scored once each for all indices of three successive days. The order the dogs were scored was randomized for each day.

*Data Analysis*

The data analysis was done at the computer center of the University of Michigan (Liebetau & McKenzie 1974). Two perma-

**Table 3**  
 Plaque scores for buccal and lingual tooth surfaces (B,L)  
 (mean scores  $\pm$  standard error)

AGE (MO)		Maxilla					
		18.2 $\pm$ .19	31.9 $\pm$ .14	43.6 $\pm$ .24	55.2 $\pm$ .14	67.2 $\pm$ .14	79.2 $\pm$ .32
I <sub>2</sub>	B	2.13 $\pm$ .28	2.21 $\pm$ .26	2.32 $\pm$ .35	1.75 $\pm$ .36	1.63 $\pm$ .28	2.67 $\pm$ .33
	L	1.50 $\pm$ .28	2.00 $\pm$ .18	1.73 $\pm$ .25	1.17 $\pm$ .26	1.21 $\pm$ .22	2.25 $\pm$ .21
C	B	3.54 $\pm$ .38	4.25 $\pm$ .17	4.36 $\pm$ .18	4.13 $\pm$ .19	4.33 $\pm$ .21	4.67 $\pm$ .21
	L	2.38 $\pm$ .25	2.63 $\pm$ .21	2.64 $\pm$ .18	2.17 $\pm$ .29	2.54 $\pm$ .26	3.33 $\pm$ .17
P <sub>2</sub>	B	4.38 $\pm$ .30	4.41 $\pm$ .30	4.90 $\pm$ .10	4.64 $\pm$ .17	4.95 $\pm$ .05	5.00
	L	2.38 $\pm$ .13	2.32 $\pm$ .25	2.75 $\pm$ .23	1.91 $\pm$ .41	2.68 $\pm$ .18	4.00 $\pm$ .52
P <sub>4</sub>	B	5.00	5.00	5.00	5.00	5.00	5.00
	L	1.92 $\pm$ .14	1.50 $\pm$ .15	2.23 $\pm$ .29	1.87 $\pm$ .22	1.92 $\pm$ .18	2.33 $\pm$ .31
M <sub>1</sub>	B	4.83 $\pm$ .17	5.00	4.95 $\pm$ .05	4.88 $\pm$ .13	5.00	5.00
	L	1.04 $\pm$ .11	.92 $\pm$ .08	1.18 $\pm$ .14	1.00 $\pm$ .12	1.29 $\pm$ .19	1.42 $\pm$ .27
		Mandible					
I <sub>2</sub>	B	1.33 $\pm$ .25	1.63 $\pm$ .23	2.23 $\pm$ .38	1.13 $\pm$ .33	.92 $\pm$ .27	1.83 $\pm$ .44
	L	1.29 $\pm$ .22	1.75 $\pm$ .22	1.91 $\pm$ .39	1.08 $\pm$ .30	1.38 $\pm$ .25	2.00 $\pm$ .34
C	B	3.00 $\pm$ .33	3.50 $\pm$ .22	3.73 $\pm$ .25	3.33 $\pm$ .36	3.21 $\pm$ .33	4.42 $\pm$ .49
	L	1.67 $\pm$ .28	2.08 $\pm$ .23	2.55 $\pm$ .23	2.00 $\pm$ .20	2.50 $\pm$ .29	2.92 $\pm$ .54
P <sub>2</sub>	B	4.58 $\pm$ .19	4.58 $\pm$ .25	4.95 $\pm$ .05	4.90 $\pm$ .10	4.83 $\pm$ .17	5.00
	L	3.75 $\pm$ .33	3.71 $\pm$ .31	4.80 $\pm$ .08	4.10 $\pm$ .31	4.63 $\pm$ .25	4.33 $\pm$ .67
P <sub>4</sub>	B	5.00	4.91 $\pm$ .09	4.90 $\pm$ .10	4.94 $\pm$ .06	4.86 $\pm$ .14	5.00
	L	3.83 $\pm$ .24	2.55 $\pm$ .30	3.15 $\pm$ .38	3.39 $\pm$ .38	3.91 $\pm$ .36	4.60 $\pm$ .29
M <sub>1</sub>	B	4.08 $\pm$ .31	3.83 $\pm$ .34	4.23 $\pm$ .30	3.38 $\pm$ .33	3.58 $\pm$ .40	4.00 $\pm$ .63
	L	1.38 $\pm$ .13	1.25 $\pm$ .18	1.55 $\pm$ .18	1.13 $\pm$ .15	1.63 $\pm$ .18	1.83 $\pm$ .11

ment data files were created, the sample dogs and the standardization dogs. Data analysis was done using the Michigan Interactive Data Analysis System (MIDAS) programs (Fox & Guire 1973).

For the sample dogs, descriptive statistics were computed for the respective age groupings with regards to each tooth surface for the variables of gingivitis, calculus, plaque, loss of attachment, pocket depth, and width of the keratinized gingiva. Before achieving the age group means, each dog had the bilaterally opposite teeth paired. Mean scores were then obtained from paired teeth within each age grouping.

The standardization dogs were organized into two groups: the group scored at the beginning of the study, and the group

scored at the end of the study. The various indices used were analyzed for scoring deviation for each group and for the combined groups. Reproducibility was also analyzed by analysis of variance for the same successive scorings of the first and second group of standardization dogs.

### Results

Complete descriptive statistics for all the parameters scored were tabulated by age, tooth, surface, and index. Various condensed tables and graphs of mean scores  $\pm$  S.E. of the mean of the indices for various tooth surfaces related to age are presented. Due to inadequate sample size for statistical evaluation in the age groups greater than

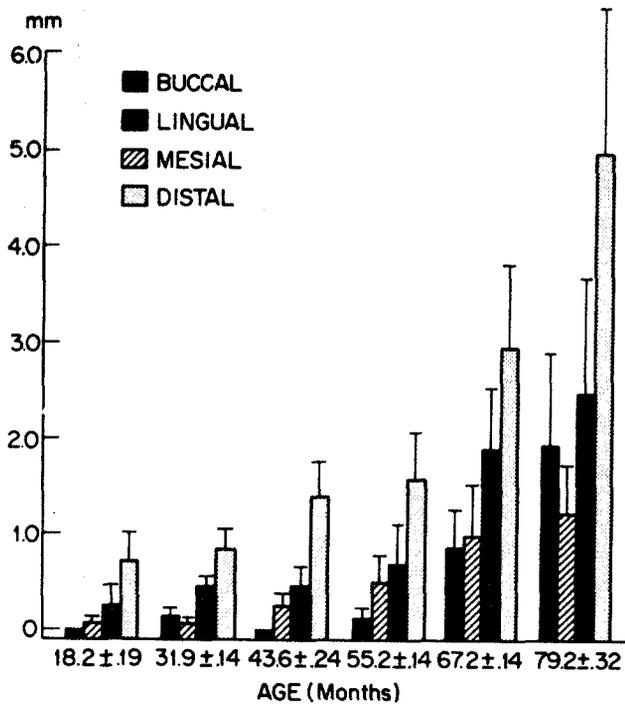


Fig. 1. Loss of attachment for maxillary P4 surfaces (mean scores in mm ± standard error).

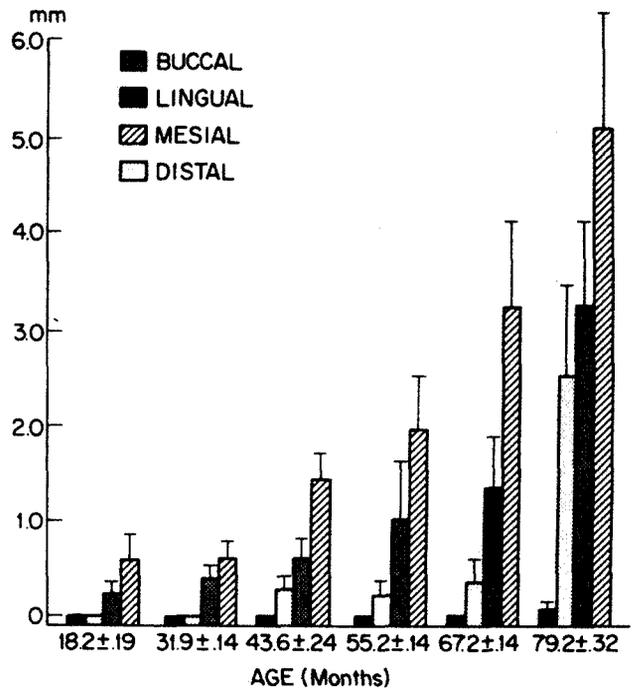


Fig. 2. Loss of attachment for maxillary M1 surfaces (mean scores in mm ± standard error).

six to seven years, these dogs will be discussed only in general terms.

**Gingivitis**

Mean gingivitis scores are given in Table 1. Gingivitis scores were generally greater at older ages for the buccal gingiva of the P2, P4, and M1. This was most consistent for the maxilla, with the buccal gingiva for the maxillary P4 usually having the highest gingivitis score within the age groups and area scores. The lingual gingiva of P2, P4, and M1 had less gingivitis than the corresponding buccal gingiva. The smallest age-related differences in gingivitis occurred for the I2 and C gingiva.

**Calculus**

Mean calculus scores are given in Table 2. Calculus scores were higher for the buccal surfaces of the posterior teeth in older than in younger dogs. The maxillary buccal surface of the P4 consistently had the highest calculus score, followed by the maxillary M1 and mandibular P4 buccal surfaces.

Calculus scores were lower for the I2, C, mandibular M1, and lingual surfaces of P2 and P4.

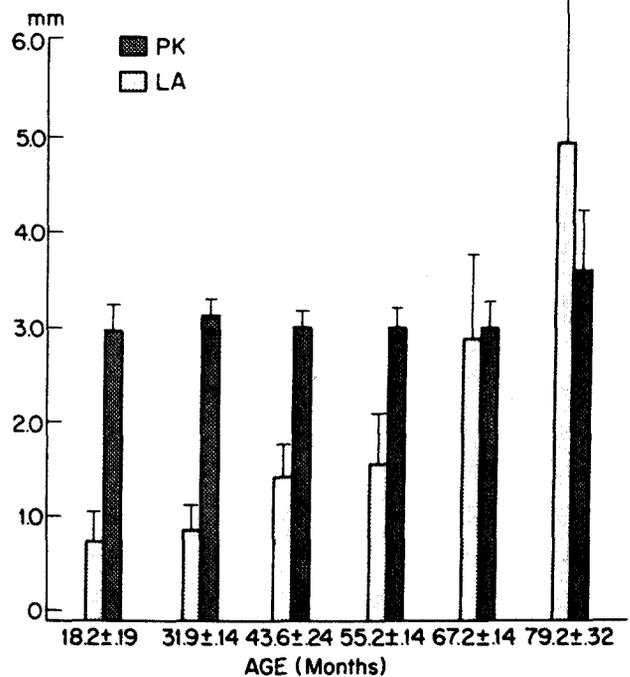


Fig. 3. Interproximal pocket depth (PK) and loss of attachment (LA) for the maxillary P4 distal surface (mean scores in mm ± standard error).

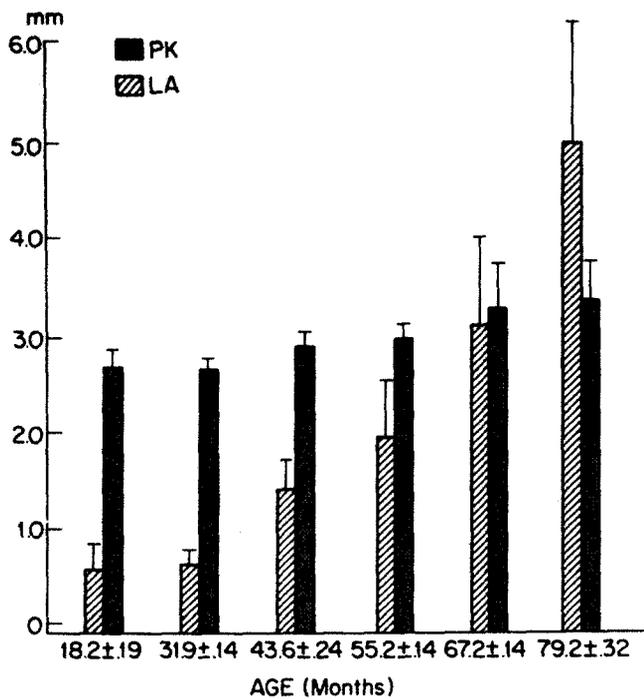


Fig. 4. Interproximal pocket depth (PK) and loss of attachment (LA) for the maxillary M1 mesial surface (mean scores in mm  $\pm$  standard error).

### Plaque

Mean plaque scores are given in Table 3. Plaque scores in both the maxilla and mandible were higher on buccal than lingual surfaces. They were also progressively higher from the anterior to the posterior of the mouth on the buccal surfaces to maximum values on P4. Plaque scores were consistently highest on the buccal surface of the maxillary P4 with maximum values at a very early age. Plaque scores also increased on the lingual surfaces from the anterior to the posterior, and then decreased on P4 and M1.

### Loss of Attachment

Loss of attachment was greater on specific surfaces for older dogs in the premolars and molar regions. Loss of attachment is shown for the maxillary P4 surfaces in Figure 1. The maxillary P4 exhibited greater differences for loss of attachment on all surfaces with older dogs. This was

greatest on the distal surface. Loss of attachment for the maxillary M1 is shown in Figure 2. There were age related differences in loss of attachment on the mesial, buccal, and distal surfaces. The lingual surface of the maxillary M1 had very little difference in loss of attachment between age groups.

### Pocket Depth

Comparisons of pocket depth and loss of attachment for the distal surface of the maxillary P4 and mesial surface of the maxillary M1 are given in Figures 3 and 4. Loss of attachment and pocket depth did not have the same relationship at different ages. Except for the oldest animals, pocket depth was nearly the same for all groups, but loss of attachment was greater with each age group.

### Keratinized Gingiva

The width of keratinized gingiva, pocket

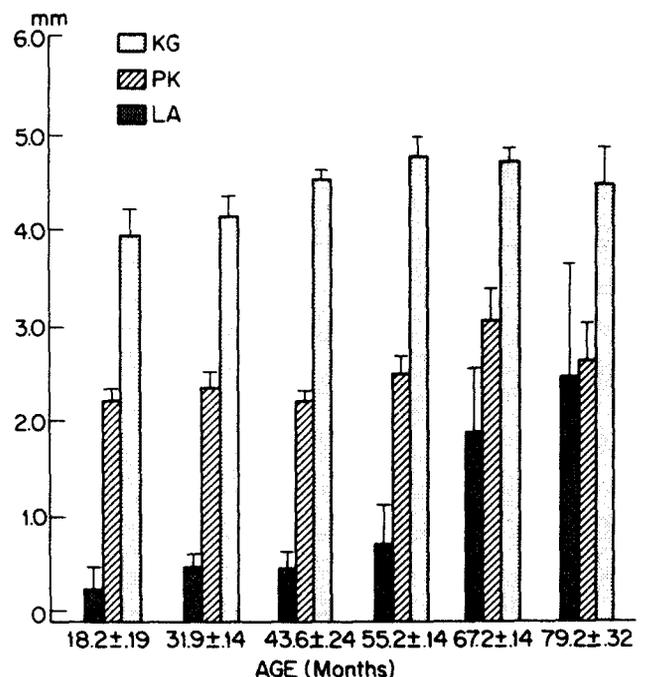


Fig. 5. Keratinized gingiva (KG), pocket depth (PK), and loss of attachment (LA) for maxillary P4 buccal surface (mean scores in mm  $\pm$  standard error).

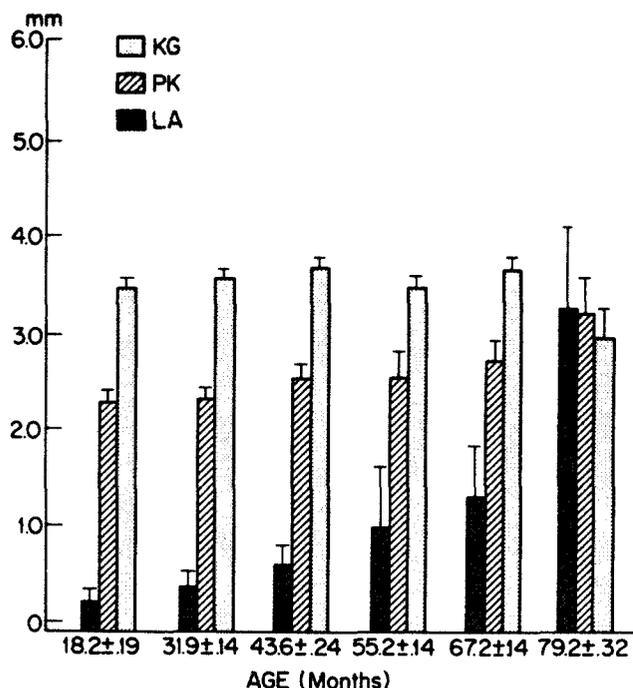


Fig. 6. Keratinized gingiva (KG), pocket depth (PK), and loss of attachment (LA) for the maxillary M1 buccal surface (mean scores in mm  $\pm$  standard error).

depth, and loss of attachment for the buccal surfaces of the maxillary P4 and M1 are shown in Figures 5 and 6. A slightly greater width of keratinized gingiva was seen with age groups up to five years of age than in older animals. This suggests that a greater loss of attachment is accompanied by a slight decrease in width of the keratinized gingiva.

#### Scoring Reproducibility

Average deviation per score and percent of no change for gingivitis, calculus, plaque, loss of attachment, pocket depth, and keratinized gingiva for the standardization dogs were calculated. Generally the percent of no change increased from the first to second testing.

Analysis of variance of the scoring error of the various indices for the standardization study at the start of the investigation and the end of the study were calculated. The variation of plaque scores was the most

significant ( $p = .001$ ) in the first standardization study. Analysis of variance for the second standardization study showed the scoring errors in reproducibility not to be significant or at a low level of significance.

#### Discussion

Scores for gingivitis, loss of attachment, calculus, and plaque or oral debris have been used previously in longitudinal (Saxe et al. 1965, 1967, Lindhe et al. 1973, 1975) and cross sectional studies (Rosenberg & Emmering 1962) of periodontal disease in beagle dogs. These studies have reported a progressive increase of the mean scores for gingivitis, calculus, and plaque or oral debris with age. The present study shows that this increase is not generalized throughout the mouth. Gingivitis scores changed very little in the maxillary and mandibular incisor and canine regions when compared to the premolar regions. Also the lingual gingiva of the maxillary M1 and both the lingual and buccal gingiva of the mandibular M1 showed little variation in mean gingivitis scores with regards to age.

Calculus scores tended to parallel gingivitis scores for the various areas. The observed pattern of distribution of calculus, and similar pattern and severity of gingivitis with age agrees with that published (Rosenberg et al. 1966). The nature of calculus deposition may account for the noted recession. Calculus was observed as a solid sheet on the buccal surfaces of the C through M1, with increasing amounts up to the P4. Calculus eventually often covered the entire buccal surface to the cusp tip in the premolars and M1. The presence of subgingival calculus was usually observed in these areas as a progression of the large supragingival deposits extending into the sulcus, which agrees with the observations of others (Reh-

feld & Sorenson 1960). Heavy deposits of supragingival calculus were not observed on the lingual surfaces of the mandibular incisors. This may be due to the posterior position of the orifice of the submandibular glands in the region of the P1. The supra-gingival calculus depositions appeared to be related in formation and amount to the approximation of the involved tooth surfaces to the parotid gland duct, as pointed out by others (Rehfeld & Sorenson 1960).

Plaque scores showed only slight to moderate differences with age. In the youngest age groups maximum scores were present on the buccal surface of the maxillary P4. The buccal surfaces of the other premolars, and the canines also had high plaque scores. The buccal surfaces of the first molars had initially high scores in the maxilla, and moderate plaque accumulations in the mandible. Plaque accumulation was only slight on the incisors and lingual surfaces of the maxillary P4 and M1. Using a technique with complete saturation of all the teeth with disclosing solution, there was very little to no plaque observed on the maxillary M2 or the mandibular M2 and M3. Plaque accumulations are possibly related to the cleansing action of the lips for the incisors, the buccal mucosa in the posterior molars, and the tongue on the lingual surfaces. The commissure of the mouth approaches the P4 and M1 with very loose adaptation. Cleansing potential of the lips in this region may be minimal. It is also possible that plaque accumulation is directly related to and potentiated by the pattern of calculus deposition.

Loss of attachment was observed to increase with age for certain teeth and surfaces, while other teeth had very little change. The overall severity of loss of attachment increased considerably at six to seven years of age. Pocket depth also increased with age, but this increase was not generalized to all tooth surfaces. Pocket

depth did not increase as much with age as did loss of attachment. Periodontal disease in the beagle dogs included a moderate to severe recession with only slight to moderate increases in pocket depth.

Previous investigations in beagle dogs have been done to assess longitudinal loss of attachment (Saxe et al. 1965, 1967). Notches were used on select teeth as reference points. They showed a progressive loss of attachment with time, but the findings were not related to specific teeth and surfaces. Similar procedures have been used to calibrate the loss of attachment over eighteen months (Lindhe et al. 1973) and four years (Lindhe et al. 1975) in beagle dogs from ten months of age by using amalgam fillings as reference points. The results (Lindhe et al. 1973) were presented as mean scores of buccal surfaces for incisors, premolars, and molars, with regards to age. They observed more loss of attachment for the incisors in dogs of comparable age than in this study. This difference may be related to the difficulty in determining the cemento-enamel junction by probing in the incisor regions.

When severe destruction of supporting structures was noted there was often a reduction or lack of keratinized gingiva. This was most often seen on the buccal surfaces of the P2 though M1 in both the maxilla and mandible. A lack of keratinized gingiva was usually associated with severe furcation involvement and advanced loss of attachment.

Periodontal disease in the beagle dog increased in severity with age. Changes ranged from mild marginal gingivitis to severe destruction of the supporting tissues. The severity of change varied in specific areas with high plaque accumulation, gingivitis, calculus formation, moderate to severe loss of attachment, and slight to moderate pocket formation.

### Acknowledgment

This investigation was supported by the Dental Research Institute, Grant # DE 02731.

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