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Validation of Use of Subsets of Teeth When Applying the Total Mouth Periodontal Score (TMPS) System in Dogs

Colin E. Harvey, BVSc, FRCVS; Larry Laster, PhD; Frances S. Shofer, PhD

Summary:

A total mouth periodontal score (TMPS) system in dogs has been described previously. Use of buccal and palatal/lingual surfaces of all teeth requires observation and recording of 120 gingivitis scores and 120 periodontitis scores. Although the result is a reliable, repeatable assessment of the extent of periodontal disease in the mouth, observing and recording 240 data points is time-consuming. Using data from a previously reported study of periodontal disease in dogs, correlation analysis was used to determine whether use of any of seven different subsets of teeth can generate TMPS subset gingivitis and periodontitis scores that are highly correlated with TMPS all-site, all-teeth scores. Overall, gingivitis scores were less highly correlated than periodontitis scores. The minimal tooth set with a significant intra-class correlation (≥ 0.9 of means of right and left sides) for both gingivitis scores and attachment loss measurements consisted of the buccal surface of the maxillary third incisor, canine, third premolar, fourth premolar, and first molar teeth; and, the mandibular canine, third premolar, fourth premolar, and first molar teeth on one side (9 teeth, 15 root sites). Use of this subset of teeth, which reduces the number of data points per dog from 240 to 30 for gingivitis and periodontitis at each scoring episode, is recommended when calculating the gingivitis and periodontitis scores using the TMPS system. ***J Vet Dent 29(4); 222 - 226, 2012***

Introduction

Recently, a total mouth periodontal score (TMPS) system was described for use in dogs.[1] The system required scoring all root sites and used a weighting system based on gingival circumference (for TMPS-Gingivitis) and root surface area (for TMPS-Periodontitis) that produced a single score to reflect the contributions of periodontal disease as gingivitis or as attachment loss of all teeth in the mouth. TMPS provides an accurate, repeatable means of measuring the extent of insult to the oral cavity resulting from periodontal disease. As initially described,[1] TMPS requires scoring 120 root sites in the mouth of a dog, which is tedious even for a well-trained and motivated scorer.

Although there are data available to demonstrate that some teeth are more likely than others to develop loss of attachment in dogs [2], that teeth of dogs vary considerably in shape and size[1,3], and that use of a convenient set of large and readily examined teeth is recommended for trials of rate of plaque and calculus accumulation[4], there are no studies available to date that validate selection of specific teeth or sets of teeth as representative of the full extent of periodontal disease in the mouth for correlation with systemic health. There are now several published studies that demonstrate an association between periodontal disease and systemic or distant organ effects in dogs.[5,6,7] A convenient and validated method of measuring the extent of periodontal disease would allow direct comparison of such studies and enhance our knowledge of these interactions.

In this study, data from a series of canine periodontal patients that were scored using the full 120-site TMPS system were analyzed to test whether use of selected subsets of teeth can be validated.

Materials and Methods

As part of a recent study,[7] the teeth of 34 canine patients with periodontal disease (of a wide range in severity) were scored using the full TMPS-Gingivitis and TMPS-Periodontitis 120 root site system. These data are used in this study for analysis of subsets of teeth and correlation of the results with the full TMPS scores. TMPS-Gingivitis uses a gingival bleeding index, and TMPS-Periodontitis uses the maximum depth in mm from CEJ to bottom of pocket at each root site.[1]

The subsets examined were:

- **A** One side only, buccal root sites only. All maxillary and mandibular teeth (21 teeth, 31 root sites).
- **B** One side only, buccal sites only. Maxilla: first, second and third incisor, canine, second premolar, third premolar, fourth premolar, and first molar teeth. Mandible: first, second and third incisor, canine, second premolar, third premolar, fourth premolar, first molar, and second molar teeth (17 teeth, 26 root sites).
- **C** One side only, buccal sites only. Maxilla: canine, second premolar, third premolar, fourth premolar, and first molar teeth. Mandible: canine, second premolar, third premolar, fourth premolar, first molar, and second molar teeth (11 teeth, 20 root sites).
- **D** One side only, buccal sites only. Maxilla: third incisor, canine, third premolar, fourth premolar, and first molar teeth. Mandible: canine, third premolar, fourth premolar, and first molar teeth (9 teeth, 15 root sites). These are the teeth that are required to be scored in Veterinary Oral Health Council (VOHC) trials of plaque and calculus accumulationa; they are referred to in this paper as the 'VOHC set'.
- **E** One side only, buccal sites only. All maxillary sites only (10 teeth, 15 root sites).
- **F** One side only, buccal sites only. Maxilla: canine, fourth premolar, and first molar teeth. Mandible: canine and first molar teeth (5 teeth, 8 root sites).
- **G** One side only, buccal sites only. Maxilla: fourth premolar and first molar teeth (2 teeth, 4 root sites).

Statistical analysis

Agreement between specific subsets of root sites of TMPS and total mouth TMPS scores was assessed by calculating intra-class correlation coefficients (r_i). For each subset of teeth, the

Figure 1

Gingival Score and Attachment Loss – Agreement of Total Mouth Sites TMPS Scores with Subset A (21 teeth, buccal sites only, 31 root sites, right side).

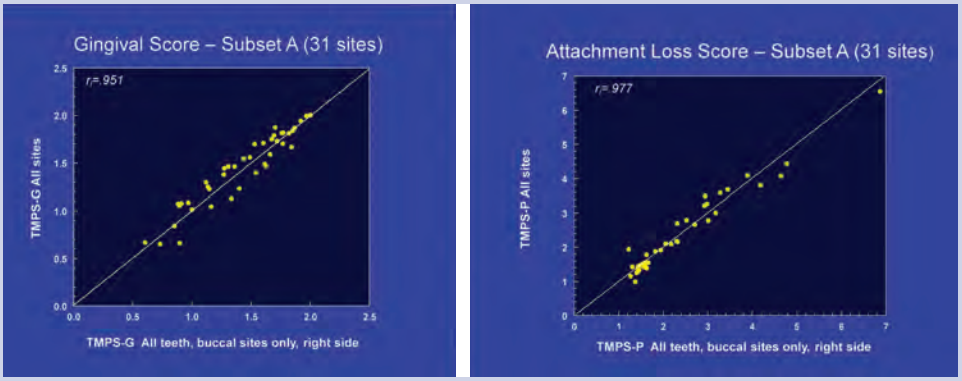


Figure 2

Gingival Score and Attachment Loss – Agreement of Total Mouth Sites TMPS Scores with Subset B (17 teeth, buccal sites only, 26 root sites, right side).

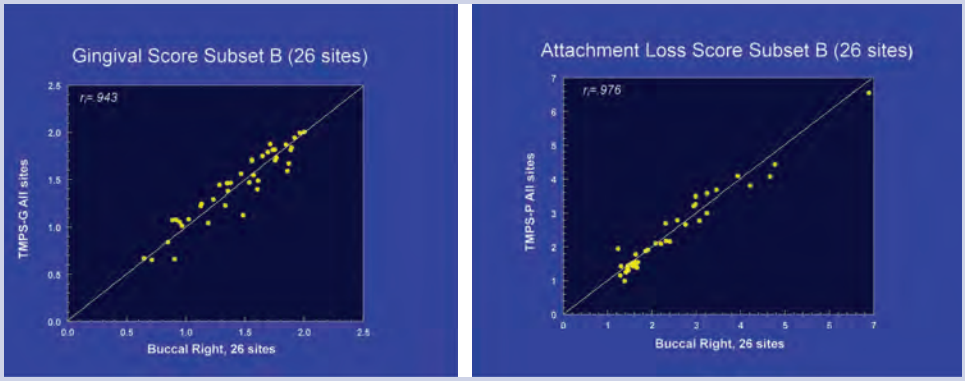


Figure 3

Gingival Score and Attachment Loss – Agreement of Total Mouth Sites TMPS Scores with Subset C (11 teeth, buccal sites only, 20 root sites, right side).

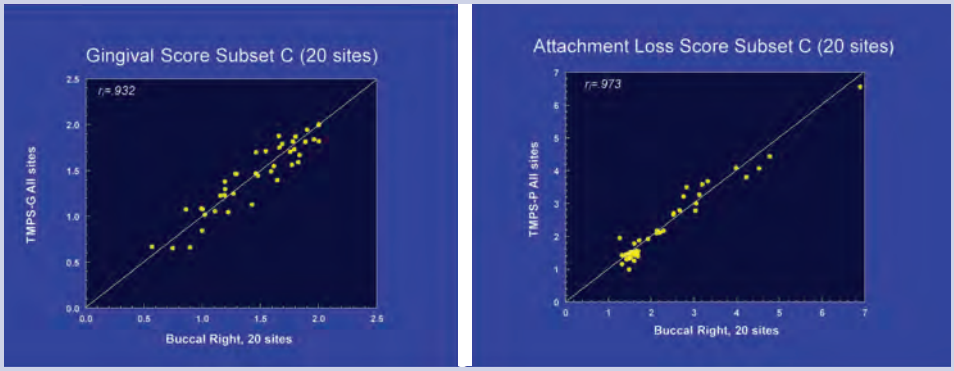


Table 1

Intra-class correlation coefficients of TMPS-G and TMPS-P.

All Sites versus Subset Sites

			TMPS-G (Gingival Score)			TMPS-P (Attachment Loss)*		
Subset	**Number of Teeth**	**Number of Root Sites**	**Left**	**Right**	**Average**	**Left**	**Right**	**Average†**
A	21	31	0.926	0.951	0.9	0.979	0.977	1.0
B	17	26	0.920	0.943	0.9	0.979	0.976	1.0
C	11	20	0.901	0.932	0.9	0.975	0.973	1.0
D	9	15	0.857	0.918	0.9	0.969	0.966	1.0
E	10	15	0.782	0.826	0.8	0.919	0.945	0.9
F	5	8	0.697	0.790	0.7	0.944	0.935	0.9
G	2	4	0.366	0.442	0.4	0.800	0.781	0.8

* = r_i intra-class correlation coefficient. For all of the subset r_i values shown, the probability of a significant correlation of the subset with the whole-mouth data set is <0.005.

† = average of right and left sides, rounded to nearest 0.1.

r_i coefficients for the right and lefts sides for each subset were compared. A difference in r_i between the right and left side data of ≤ 0.06 was accepted as indicating agreement between the two sides.

An average of the right and left side r_i of ≥ 0.9 was considered to be a conservative indicator that a specific subset is valid as a reliable representation of TMPS score. It has been reported that intra-class r's > 0.75 "represent excellent reliability."[7]

An analysis, that also measures the extent of agreement between two sets of data by using a graphical plot analysis approach, was used to assess the level of agreement between the gingivitis scores for all sites and the gingivitis scores for buccal sites only.[8] This same analysis was used for the attachment loss scores for all sites and the attachment loss scores for buccal sites only, as an alternate method of confirming the reliability of use of subsets of teeth for TMPS.[8]

Results

Intra-class correlation coefficients for the analysis of the data for the seven subsets as compared with the all-sites TMPS data are presented (Table 1). All of the calculated r_i values are statistically significant ($p < 0.005$).

The average r_i between the TMPS data for the right side and the left side was within the 0.05 agreed requirement for subsets A-E. The rounded mean of the right and left side r_i values for subsets A-D was 0.9 or 1.0 for both gingivitis and attachment loss scores (Table 1, Figs. 1-7). For the gingival scores, the r_i values were below 0.8 for subsets E, F, and G on one or both sides. There was excellent agreement of the all-site and subset data for attachment loss for every subset except subset G (0.80, 0.78). Thus, subsets A-D met the requirements stated in the Materials and Methods section for validation that the subset gingivitis and attachment loss scores are significantly correlated with the all-site gingivitis and attachment loss TMPS scores.

Analyses[8] indicate that there was good agreement between the all-site gingivitis scores and the buccal site gingivitis scores and between the all-site attachment loss scores and the buccal site attachment loss scores (Fig. 8). Only 4 values fell outside the limits of agreement for attachment loss (-0.25, 0.46) and 2 were outside the limits of agreement for gingivitis scores (-0.09, 0.21).

Discussion

Tooth subset D (the 'VOHC set') is recommended as a statistically reliable and time-efficient means of scoring gingivitis and attachment loss when using the TMPS system for several reasons:

- Restricting the scored root set to one side of the mouth reduces the number of sites needing to be scored and avoids the need to reposition the dog during the scoring episode.
- Restricting the scored root site set to only the buccal sites reduces the number of sites needing to be scored, and eliminates the palatal-lingual sites, which are physically more awkward to observe.
- It is the smallest set of root sites that provides sufficiently high statistical correlation with the total mouth set. Therefore, of all of the sets with sufficiently high statistical correlation, it will take the least time to score a mouth.
- Compared with teeth not included in this set, the teeth are large and thus easier to score. They can also all be seen conveniently on lateral view, thus minimizing need of the scorer to change position or for the dog's head to be repositioned.
- The set is an established subset for scoring plaque and calculus,[4] and lends itself to trials in which the 'VOHC set'[a] is used for other reasons.

Correlations for gingival scores were generally lower, and slightly below r_i 0.9 at a larger root site number, than for attachment loss. This difference is likely due to the different nature of the two categories: gingivitis is a categorical score for which 0, 1, 2 or 3 are the only observations permitted, whereas attachment loss is a continuous variable. If a study was to measure only attachment loss, the data reported here support scoring unilateral subsets as small as five teeth (8 sites) as valid; however, because most studies that include attachment loss scoring will also include gingivitis scoring, use of the 15 site subset D (the 'VOHC set') is recommended.

There was excellent correlation between the right and left side subset scores for subsets A-E.

Although there was good agreement between the all-site scores and the buccal-only site scores[8] (Fig. 8), it should be noted that the score from a validated subset is not expected to be exactly the same as the score using all sites. As long as a study is conducted using the same subset on all subjects examined, the subset TMPS score remains valid.

Because the data reported here were produced using the gingival bleeding index score and attachment loss measurement described in the original TMPS paper,[1] the validation of subset scores of gingivitis and attachment loss reported here does not necessarily apply to other scoring systems for periodontal pathology.

Conclusions

To minimize time required for scoring and data entry, use of the TMPS score-weighting system based on a unilateral subset of 9 teeth (15 root sites, the 'VOHC set'[a]), consisting of maxillary third incisor, canine, third premolar, fourth premolar, and first molar teeth; and, mandibular canine, third premolar, fourth premolar and first molar teeth, is valid. Use of subsets smaller than this subset cannot be supported for studies involving gingivitis scoring.

TMPS spreadsheet availability

The TMPS spreadsheet with weighting factors using the minimally-acceptable root site subset D as validated in this study will be made available on request. No computer skills other than data entry into a spreadsheet are required. Insert the scoring

Figure 4

Gingival Score and Attachment Loss – Agreement of Total Mouth Sites TMPS Scores with Subset D (9 teeth, buccal sites only, 15 root sites, right side).

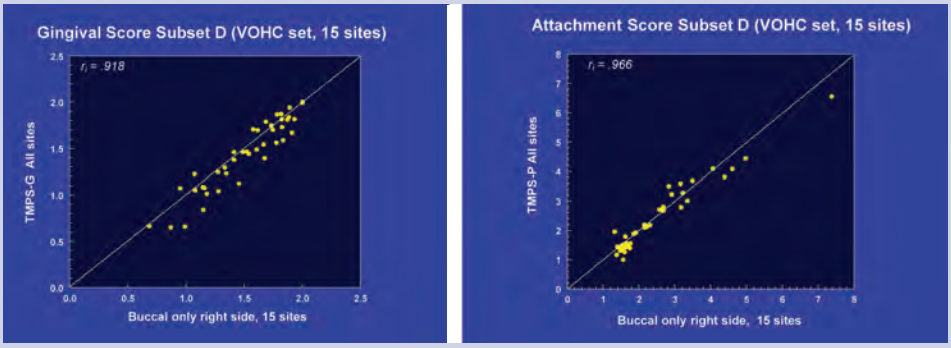


Figure 5

Gingival Score and Attachment Loss – Agreement of Total Mouth Sites TMPS Scores with Subset E (10 teeth, buccal sites only, 15 root sites, right side).

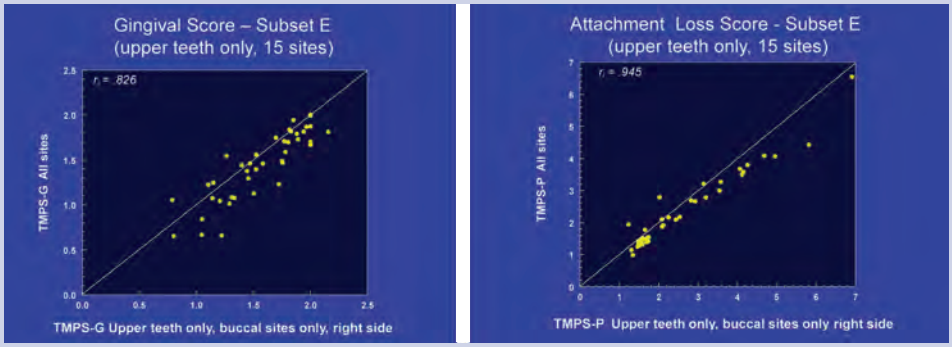


Figure 6

Gingival Score and Attachment Loss – Agreement of Total Mouth Sites TMPS Scores with Subset F (5 teeth, buccal sites only, 8 root sites, right side).

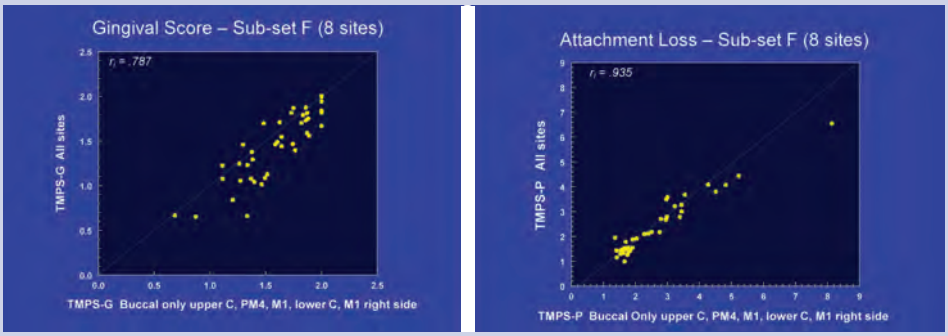


Figure 7

Gingival Score and Attachment Loss – Agreement of Total Mouth Sites TMPS Scores with Subset G (2 teeth, buccal sites only, 4 root sites, right side).

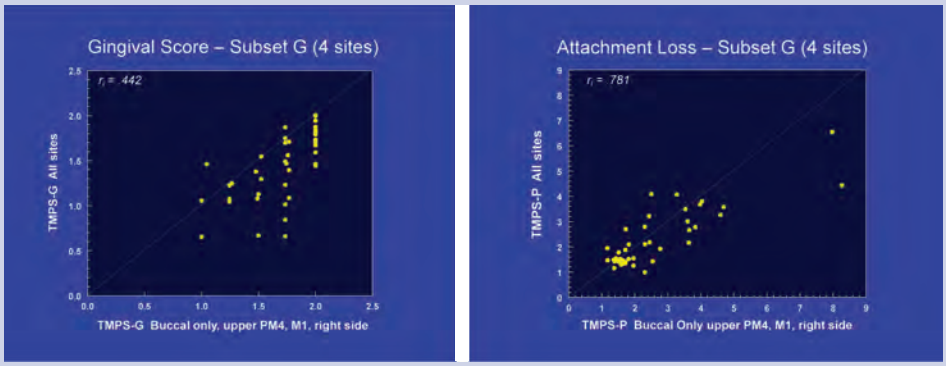
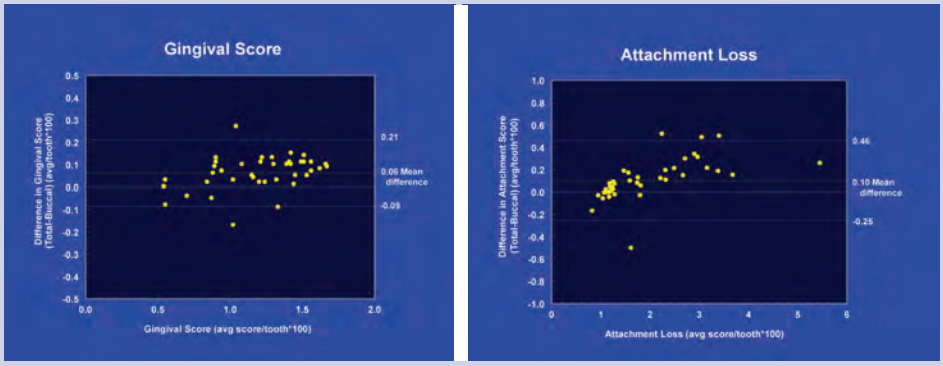


Figure 8

Analysis of Agreement[8]:
Gingival Score: all sites compared with buccal sites only, right side.
Attachment Loss: all sites compare with buccal sites only, right side.



The horizontal dashed line indicates the mean difference (0.06 Gingival; 0.1 Attachment Loss) and the horizontal dotted lines indicate the limits of agreement ± 2 SD around the mean difference.

data into a blank copy of the electronic TMPS spread-sheet; the TMPS-G and TMPS-P will be automatically calculated. The TMPS spreadsheet is copyrighted by Colin Harvey and the University of Pennsylvania. It can be down-loaded from www.ceHarvey.com – click the Validated Subset TMPS link on the web site. Permission to use TMPS is granted provided that the source of the program is cited as TMPS© Colin Harvey and the University of Pennsylvania in any reports or publications that include use of TMPS.

[a] http://www.vohc.org/protocol.htm#teeth

Author Information

From the University of Pennsylvania, Ryan-VHUP 3113, 3900 Delancey Street, Philadelphia, PA 19104, USA. E-mail: ceh@vet.upenn.edu

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