A Comparison of Dental Cleaning Techniques in Anesthetized and Non-anesthetized Dogs

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Abstract

The primary purpose of this study was to compare the results of dental cleanings performed when dogs are anesthetized (AD) versus those that are non-anesthetized (NAD). In addition, complete oral examinations were performed on all anesthetized study patients including full-mouth dental radiographs to further investigate the ability to identify patients that do not require any dental treatment beyond scaling and polishing of the teeth. Sixty dogs were enrolled in the study from a privately-owned small animal hospital. A split mouth study design was utilized to compare the results where one half of the mouth was cleaned by individuals trained to perform the NAD cleanings and the other half cleaned by individuals trained to perform AD cleanings. Immediately following the cleanings, full mouth dental radiographs were obtained, and residual plaque and calculus scoring was performed by blinded scorers. Eight dogs displayed behavior that precluded the cleaning without anesthesia and one dog was not presented as instructed. Results of the residual plaque and calculus scoring of the fifty-one dogs that completed the study were analyzed and there was no statistical difference in the residual levels of plaque or calculus between the NAD or AD technique. Based on results of oral examination and dental radiographs under anesthesia, forty-three (84.3%) of the fifty-one patients that completed the study required treatment of dental disease that requires general anesthesia (periodontal therapy, periodontal surgery, dental extractions or endodontic treatment); including nine dogs that received dental care including dental radiographs under anesthesia within the previous 12 months. If the eight dogs that were excluded from the study due to behavior are also considered, fifty-one of fifty-nine (86.4%) dogs presented for the study were not considered candidates for the NAD cleaning technique. Although this study did not show any statistical difference between the results of NAD or AD cleanings, it demonstrated that the prevalence of dental disease requiring treatment under anesthesia in a client-owned population of dogs is high, even in patients who receive annual dental care with dental radiographs under anesthesia. These results bring into question the benefit of performing dental cleaning procedures on dogs without the use of anesthesia, when oral health cannot be completely evaluated and treated.

Introduction

Periodontal disease has been identified as the most common disease of domestic dogs (1). Despite advances in veterinary oral healthcare, periodontal disease does not appear to be well controlled in the general companion dog population. In people, periodontal disease is prevented with daily plaque control (brushing and flossing typically) in the home and periodic professional dental cleanings performed by licensed dentists or dental hygienists (www.ada.org, www.adha.org). Daily brushing has been demonstrated to be effective for preventing periodontal disease in dogs (2). However, daily brushing in the home environment rarely occurs, which may be due to patient behavioral problems, lack of owner compliance, or lack of recommendations by the primary care veterinarian (3). Products such as dental chews and dental diets that claim to prevent periodontal disease in dogs have become

popular alternatives or adjuncts to daily brushing. However, a recent study showed that daily brushing was more than three times as effective as either a daily dental chew or feeding a dental diet for controlling plaque levels in dogs (4). Therefore, prevention of periodontal disease in most dogs relies solely on professional dental cleanings.

Dental cleanings in dogs have traditionally utilized general anesthesia. These procedures are performed inside of veterinary facilities under the direct supervision of licensed veterinarians by personnel with varying degrees of training and experience. The exact origination of NAD cleanings in dogs is unknown. NAD cleanings are currently being performed inside of veterinary practices as well as non-veterinary-licensed facilities in many states. To the authors knowledge, the NAD procedures are performed by personnel with varying degrees of training and experience. Some individual state veterinary boards have outlawed NAD cleanings, when not performed under the supervision of a veterinarian. Dental cleanings without the use of anesthesia are sometimes marketed as a safer, less costly alternative to the traditional procedure, or a procedure to be performed between AD cleanings. Controversy within the veterinary profession and confusion among pet owners exists about which type of procedure and at what interval is best for dogs.

Development of dental cleaning methods for dogs that do not utilize general anesthesia has led to supportive and oppositional arguments by veterinary professionals and non-professionals (5,6). The supportive arguments for NAD procedures are that they cost less, eliminate the risks of anesthetic complications, and serve to maintain oral health between AD procedures. The American Veterinary Dental College (www.avdc.org), American College of Veterinary Anesthesia and Analgesia (www.acvaa.org), American Veterinary Medical Association (www.avma.org) and European Veterinary Dental College (www.evdc.org) have all developed position statements opposing dental care for dogs performed without the use of general anesthesia. In addition to these position statements, The American Animal Hospital Association (www.aaha.org) and World Small Animal Veterinary Association (www.wsava.org) have both published dental care guidelines, which recommend general anesthesia for all patients receiving dental care. The major arguments opposing dental procedures that do not utilize anesthesia are that: all supragingival and subgingival surfaces of all teeth cannot be thoroughly cleaned if general anesthesia is not utilized, a thorough oral examination including periodontal probing and dental radiography cannot be performed if general anesthesia is not utilized, treatment of advanced dental disease cannot be provided, clients may be misled by procedures that do not fully evaluate dental health, the welfare of animals may be compromised if there is a delay in proper diagnosis and treatment of painful diseases, the safety of patients may be compromised if they are awake and may be responsive when sharp instruments used to clean the teeth are present in the mouth; the safety of the patient may be compromised if they are not intubated and therefore do not have a protected airway when working with fluids in the mouth that could be aspirated, the safety of the patient may be compromised if they experience excessive stress related to the restraint and discomfort of a procedure they don't understand, the safety of the person performing the cleaning could be compromised if the patient has an aggressive response to a pain stimulus or fear associated with a procedure they don't understand.

Of all the arguments listed above, minimal scientific evidence is available to support any of them except for several studies that have demonstrated significant value of dental radiography for identifying dental disease in dogs (7,8). One recent study on the prevalence of periodontal disease in a large population of breeding dogs in the US showed that the dogs who had received non-professional dental scaling, described as "scraping the teeth to remove calculus at least once per year," were actually at an increased risk for periodontal disease compared to those dogs that did not receive the dental scaling (9). This study, however, did not evaluate a cleaning procedure where all supragingival and subgingival surfaces of all teeth are scaled and polished without the aid of anesthesia as some companies operating inside of veterinary practices claim. The main purpose of this study was to compare the effectiveness of dental cleanings performed with and without the aid of

anesthesia that both claim to scale and polish all supragingival and subgingival surfaces of all teeth. A secondary purpose of the study was to evaluate the ability to identify dogs that were lacking significant dental pathology without the use of anesthesia, and therefore could be considered candidates for dental cleanings without any further dental treatment recommended.

Materials and Methods

For the purposes of this study, the dental cleanings performed without the aid of anesthesia are referred to as NAD cleanings and those cleanings performed with the patient under anesthesia are referred to as AD cleanings. Sixty client-owned dogs were recruited for the study by primary care veterinarians of a privately-owned small animal hospital where the study was conducted. Dogs recruited had to be at least a year of age and considered healthy on physical examination, complete blood cell count and blood chemistry analysis. Dogs were not considered for the study if they were missing any of the major teeth that were to be utilized for plaque and calculus scoring (103,203,104,204,107,207,108, 208,109, 209, 304, 404, 307, 407, 308, 408, 309, 409), had evidence of significant dental pathology or had a history of previous spinal injuries or pain that would prohibit the NAD cleanings. Dogs were also not considered for the study if they demonstrated aggressive or anxious behavior that could make the NAD cleanings difficult or dangerous for the provider. Later as the study progressed, and patients began to be recruited, it was determined that in order to achieve the desired study population of sixty dogs, a few dogs that were missing some of the teeth included in the smaller subset should be accepted into the study.

To reduce the continuous span of time in which the hosting veterinary hospital would be out of normal operation, the study was divided into two separate phases. Both phases of the study were performed at the same veterinary hospital where all patients were recruited. Each patient admitted to the hospital for the study was assigned a case number (1-60, consecutively) for identification throughout the study and on all paper study forms. The study utilized a split mouth design, where one entire side (right or left) would receive the NAD cleaning and the other entire side would receive the AD cleaning. In order to randomize which side of the mouth would be cleaned by each technique, a set of thirty cards was inscribed with the letter “L” and a set of thirty cards was inscribed with the letter “R”. Each card was sealed in an opaque envelope, shuffled, and then numbered 1-60 to be assigned with the coinciding study case number.

All study patients were first presented for the NAD cleaning. The NAD cleanings were performed in a quiet exam room by one of four different employees of a company that provides NAD cleanings on dogs under the supervision of veterinarians at multiple veterinary hospitals throughout the United States[1]. Prior to the NAD cleanings, photographs were obtained from the front and both sides of the mouth with the lips retracted and teeth exposed. **Next, oral examination and dental charting was performed on the side of the mouth to be cleaned according to the company’s 11-step professional outpatient preventative dental (POPD) process. The purpose of the exam and charting was to identify any significant oral or dental pathology that would result in recommendations for dental care under anesthesia in a typical patient in accordance with the POPD protocol.** If the NAD exam identified pathology that would typically result in recommendations for dental radiographs or dental treatment under anesthesia, this was recorded on the patient’s NAD chart, but the patient completed the study if possible. If a patient was considered too anxious or aggressive for the NAD cleaning, this was also marked on the NAD chart and they were disqualified from the study but received a complete AD cleaning and full mouth dental radiographs.

NAD cleanings were performed according to the company’s-protocol using piezo ultrasonic instrumentation, hand scalers and curettes for scaling and an electric powered polishing unit with a prophy angle and prophy paste for polishing. Individuals performing the NAD cleanings sat on the floor in Lotus Position (crossed legged) in a quiet exam room for the duration of the cleanings. Smaller dogs were wrapped in towels with the patient’s entire body in provider’s lap, while larger

dogs were positioned on their sides and had their head and neck straddled by the provider. Although the company's protocol typically involves using a plaque disclosing agent and ultraviolet light to check for residual plaque, this was not performed to avoid interference with the plaque scoring process of the study.

Following the NAD cleanings, patients were transferred to the hospital's dental suite and placed under general anesthesia by a veterinarian utilizing anesthesia techniques and monitoring considered to be within the standard of care according to American Animal Hospital Association guidelines. For the entire duration of general anesthesia, all patients were maintained in dorsal recumbency on tables designed for veterinary dental procedures. **Study patients received AD cleanings (ultrasonic and hand instrument scaling and polishing with a prophy angle and prophy paste on a low-speed air-driven hand piece supragingivally and subgingivally) by one of two veterinary technician specialists in dentistry (VTS *Dentistry)* on the side of the mouth that had not been previously cleaned with the NAD technique.** Following completion of the AD cleaning, photographs were again obtained of all teeth with the lips retracted. A series of full mouth intraoral dental radiographs were obtained on all patients by one of the veterinary technician specialists' in dentistry.

Patients were then transferred to another table that was not visible from the table where the AD cleanings and dental radiographs were performed. At this table, one of the veterinary technician specialists' in dentistry applied a plaque disclosing agent (2% eosin Y) to facilitate plaque scoring. A spray bottle was utilized to apply the stain to both sides of the mouth and another spray bottle containing only water was used to gently remove excess stain. One of two blinded scorers (board-certified veterinary dentists, WG or TW) was then directed to the table to perform plaque and calculus scoring and a complete oral exam and dental charting.

Identification and quantification of all residual plaque and calculus on all surfaces of all teeth was considered ideal in order for the study to be an accurate comparison of each procedure. However, plaque scoring on the lingual/palatal aspects of the teeth was predicted to be inaccurate and to the authors knowledge has not been validated in any previous studies. Therefore, we limited plaque scoring to the supragingival buccal surfaces of the specific subset of teeth that are required in clinical trials accepted by the Veterinary Oral Health Council (www.vohc.org). Plaque scoring was performed using a modification of the Turesky technique where both plaque coverage and thickness were recorded but without the division of the tooth crowns as described in the modified Logan and Boyce technique (10,11). The buccal aspect of each tooth was assigned scores for both coverage and thickness as follows:

Plaque Coverage Score	**Plaque Thickness Score**
No plaque = 0	(L) light = 1
0-24% = 1	(M) medium = 2
25-49% = 2	(D) dark = 3
50-74% = 3	
75-100% = 4	

The total score for each tooth was calculated by multiplying the numerical value for coverage by the numerical number for thickness. The total mouth score for plaque was achieved by adding together those values from all the teeth that were scored on one side of the mouth and dividing by the number of teeth scored (typically 9). In some of the study patients, teeth were missing from the subset that were intended to be scored; and in these cases the total mouth score was achieved by dividing by the number of teeth from the subset that were present, but this variability was later accounted for in the statistical analysis. The total mouth scores from the left and right sides of the mouth were kept separate so that in the statistical analysis the results of the NAD and AD cleaning methods could be compared.

Prior to calculus scoring, the disclosing agent was brushed and rinsed away from all teeth. To facilitate the visualization of calculus, the supragingival and subgingival, buccal and palatal/lingual surfaces of all teeth were dried using air from the three-way dental syringe. All suspected calculus was then removed with a sharp dental curette and if confirmed to be calculus it was scored using the same scale for coverage and thickness as the plaque scoring. Two separate total mouth scores were calculated from each side of the mouth, one from the buccal aspect of the same subset of 9 teeth used for the plaque scoring (referred to simply as the calculus score and calculated by dividing the total of the tooth scores by 9) and the other from the buccal and palatal, supragingival and subgingival surfaces of all teeth (referred to as the total calculus score and calculated by dividing the total of the scores by 21). When teeth were missing from one side of the mouth but not the other, this was again accounted for in tabulation of the total mouth scores and statistical analysis.
Following the completion of plaque and calculus scoring a complete oral examination was performed by either WG or TW that included periodontal probing and charting. If any evidence of trauma to the teeth or soft tissues of the oral cavity was identified, it was noted on the AD dental chart. The dental radiographs were reviewed for the patient by WG or TW and if treatment of dental disease was indicated, a primary care veterinarian of the hospital was notified so that communications could be made with the patient's owner for treatment planning. If a relatively simple dental treatment was indicated, either WG, TW or a primary care veterinarian of the hospital performed the treatment prior to recovery of the patient. If more involved dental treatment was indicated, arrangements were made with the client to have those treatments performed by the primary care veterinarian under a separate anesthetic event.

After the data was cleaned, we examined the distribution and dispersion of data through descriptive numerical summaries and graphical tools. In summary tables of continuous variables, the arithmetic mean, median, minimum and maximum statistics were created. In summary tables of categorical variables, counts and percentages were used. We analyzed the effects on plaque with a generalized linear mixed model (with a logit link), using the lme4 package (Bates & Sarkar, 2006) in the R environment (R Development Core Team, 2007). Patients were specified as a random factor nested within phase to control for their associated intraclass correlation. The fixed factors were method (anesthesia vs. no anesthesia), phase (phase one vs. phase two), and the interaction of method by phase.

Results

In total, sixty dogs were enrolled in the study between phases one and two. One patient did not show up for the study as recommended. Eight patients could not complete the study because of behavioral problems such as anxiety or aggression that precluded the AD cleaning technique. This resulted in fifty-one dogs completing the study, twenty-seven dogs in phase one and twenty-four dogs in phase two. The average age of the patients completing the study was 6.1 years (2.5-12.3years) and the average weight was 14.4 kg (1.6-40.4kg). There were a mix of breeds including the Yorkshire Terrier as the most common small breed dog and the Golden Retriever as the most common large breed. Two brachycephalic dogs completed the study, one French Bulldog and one Lhasa Apso, all other dogs were considered mesocephalic.
The mean (+/-SD) plaque score for AD cleanings in phase one was 0.40 (+/-0.26) and NAD cleanings was 0.24 (+/-0.15). The mean plaque score for AD cleanings in phase two was 0.39 (+/-0.21) and NAD cleanings was 0.34 (+/-0.19). For the plaque scores there was no significant difference between method or phase and no significant interaction between method and phase. The mean calculus score for AD cleanings in phase one was 0.08 (+/-0.09) and NAD cleanings was 0.06 (+/-0.11). The mean calculus score for AD cleanings in phase two was 0.04 (+/-0.07) and NAD cleanings was 0.05 (+/-0.06). For the calculus scores, there was no significant difference between method or phase and no significant interaction between method and phase. The mean total calculus score for AD cleanings

in phase one was 0.12 (+/-0.12) and NAD cleanings was 0.06 (+/-0.09). The mean total calculus score for AD cleanings in phase two was 0.09 (+/-0.11) and NAD cleanings was 0.07 (+/-0.07). For the total calculus scores, there was no significant difference between method but there was a significant difference between phases (b = -0.62%, SE = 0.13, $\chi 2(1) = 15.18$, $p < 0.001$) and a significant interaction between method and phase (b = 0.48%, SE = 0.19, $\chi 2(1) = 6.21$, $p = 0.012$).
Based on oral examinations performed by the individuals performing the NAD cleanings, recommendations were made for dental radiographs or treatment under anesthesia in forty-five of the fifty-one study patients. These recommendations were made for the radiographs to be performed immediately in thirty-five patients and for the radiographs to be performed during the next recommended dental procedure in the other ten patients. In five patients, recommendations were made to decline the NAD cleaning all together because of oral disease identified.
Based on oral examinations performed during the AD procedure by either WG or TW, recommendations were made for dental radiographs or treatments (periodontal therapy, periodontal surgery, dental extractions or endodontic treatment) to be performed in forty-six of fifty-one patients. These recommendations were based on the findings of oral pathology, that included periodontal pockets, furcation exposure, tooth mobility, gingival recession, gingival enlargement, dentin exposure, pulp exposure, discolored teeth, missing teeth, oral masses and caries. Missing teeth were identified in thirty-three of fifty-one patients. Dental abrasions and/or dental attrition were identified in thirty-two of fifty-one patients. Dental abrasions, dental attrition and missing teeth were excluded from the reasons for recommending dental radiographs or treatment. Evidence of oral trauma from either cleaning technique was not identified in any study patient.
Dental radiographs were considered clinically significant in thirty-six of fifty-one patients and resulted in recommendations for treatment in twenty-eight of fifty-one patients. Radiographic findings that were considered significant included alveolar bone loss, tooth resorption, periapical lesions, wide pulp canals, retained tooth roots, root fractures and unerupted teeth. Alveolar bone loss alone was not considered to result in recommendations for treatment unless the bone loss exceeded 50% of the supporting bone of the tooth. When significant findings from the oral examinations and dental radiographs under anesthesia were combined, eight (15.7%) of fifty-one patients did not require treatments beyond a dental cleaning however five of those eight patients were recommended for dental radiographs and/or treatments under anesthesia by the NAD group. When the eight patients that were declined for the NAD cleaning based on behavioral problems are included in the analysis, three (5.1%) of fifty-nine patients would have been considered good candidates for the NAD cleaning by the NAD group. If the recommendations by the NAD group are not considered and the eight dogs that were unable to receive the NAD cleaning are included in the analysis, eight (13.6%) of fifty-nine patients would have been considered good candidates for the NAD cleaning based on the oral examinations under anesthesia and dental radiographs.
Previous dental history was either unknown or there was no previous dental care for twenty-seven of the fifty-one patients that completed the study. Missing teeth were present in thirty-three of the fifty-one patients and were accounted for by previous dental radiographs in nine of those thirty-three patients. Only one patient had a previous NAD cleaning within the previous year, three other patients had NAD cleanings at least a year or more prior. Twenty of the patients had previous dental care and dental radiographs under anesthesia, nine of which were within the previous 12 months. Only one of the twenty patients that had previous dental care (2 years, three months prior) under anesthesia was considered a good candidate for the procedure.

Discussion

The primary goal of this study was to compare the results of cleanings performed with and without the aid of anesthesia. Results and statistical analysis revealed that both cleaning techniques appeared to be effective for removing both plaque and calculus. As anticipated, scoring the plaque and calculus levels was a challenge because the residual levels of both were

very low in all patients. Traditional plaque and calculus indices are utilized to assess levels after a period of time has passed following scaling and polishing, which would be expected to result in higher levels of both deposits. For future studies comparing cleaning techniques, it might be helpful to score plaque and calculus levels after a period of time has passed. The delayed time to scoring would naturally result in greater levels of plaque and calculus, which would result in more reliable scoring. This would also be a be a better indicator of the effectiveness of polishing techniques.

One of the arguments against NAD cleaning techniques is that they are not able to reach all surfaces of all teeth. In this study, it appeared that both techniques were very effective for removing calculus from all buccal, lingual/palatal, supragingival and subgingival surfaces of all teeth. The interproximal and distal surfaces of the teeth were not included in the scoring of calculus, because of the fear that it would lack predictability. The lack of calculus scoring interproximal and distal surfaces of the teeth is considered a limitation of this study and should be considered in future studies if such a calculus scoring index is validated. Likewise, if a plaque scoring index is developed that evaluates the surfaces of teeth other than supragingival buccal, it should be utilized in future studies of this nature.

The recruitment of adequate numbers of patients for this study from a single small animal hospital proved to be a challenge. To facilitate the recruitment process and reduce the time for which the hospital was out of normal operations, the study was divided into two separate phases. Between the two phases, the protocols were unchanged but the individuals performing the cleanings and scoring were different. This allowed for a comparison between the two phases and the different scorers and individuals performing the cleaning. The analysis of results saw no statistical difference between the scores in the two phases.

The challenge of recruiting patients also resulted in significant variability of dog breeds, ages and skull confirmation between patients. Although this study population more accurately represents the general population of pet dogs that are presented for dental cleanings, it does create variability in scoring plaque and calculus levels and in the difficulty and time required of the cleanings. The split mouth design of this study should have accounted for the lack of uniformity in patient size and breed for the cleanings. Future studies of this nature could utilize a uniform population of study dogs to increase consistency in the cleanings and scoring.

Additional concerns in the statistical analysis were the lack of uniformity in the number of teeth cleaned and scored on each side. To account for this variability, statistical analysis was performed on all teeth scored as well as a reduced number of teeth to make the subsets equal on each side. In other words, if tooth 208 was missing but not 108, statistical analysis was performed with 108 included and then performed again with 108 excluded from the data (equilibrated subset). There was no significant difference between the data analyzed between the complete and reduced/equilibrated subsets of teeth.

Regardless of the procedure type (AD versus NAD), the skill level of the person performing the cleaning and the amount of time spent cleaning are key factors in the results. The amount of time spent on the dental cleanings was not recorded in this study but could be recorded in a future study of this nature. **The people who performed the cleanings in this study were highly trained and experienced and are considered very skilled for the type of procedure they performed. Similar results of dental cleanings on dogs in a clinical situation would only be expected when properly trained individuals were performing the cleanings without any time constraints. The authors recognize that there is likely a high degree a variability in the results of dental cleanings that might be obtained by other providers of NAD and AD.**

This study showed comparable removal of plaque and calculus for both NAD and AD cleaning procedures when performed by the qualified personnel. A major concern revolves around the ability to predict and provide dental care required beyond the cleaning procedure. This study demonstrated conclusively that the majority (86.4%) of the patients required additional care beyond the cleaning. The intent of patient recruitment in this study was to enroll dogs who were thought to

have minimal dental disease and would be good candidates for NAD. Accurate assessment of the need for additional care and providing the indicated treatment can only be accomplished in anesthetized patients. If an accurate way of screening dogs for dental disease existed that did not require anesthesia, cleaning techniques employed without anesthesia could be considered, but this still leaves the ethical concerns of such procedures at question. Future studies are recommended to address any possible concerns.

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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- References

- Lund EM, Armstrong PJ, Kirk CA, Kolar LM, Klausner JS. Health status and population characteristics of dogs and cats examined at private practices in the United States. *J Am Vet Med Assoc* (1999) 214:1336-1341.
- Tromp JA, van Rijn LJ, Jansen J. Experimental gingivitis and frequency of toothbrushing in the beagle dog model. Clinical Findings. *J. Clin Periodontol* (1986a) 13:190-194
- Miller BR, Harvey CE. Compliance with oral hygiene recommendations following periodontal treatment in client-owned dogs. *J Vet Dent* (1994) 11:18-19
- **Allan RM, Adams VJ, Johnston NW. Prospective randomized blinded clinical trial assessing effectiveness of three dental plaque control methods in dogs. *JSAP* (2018)** doi: 10.1111/jsap.12964
- Charmical DT. Concern with anesthesia-free dental cleanings. *J Am Vet Med Assoc* (2016) 248:601. doi: 10.2460/javma.248.6.601
- De jong J. More on anesthesia-free dental cleanings. *J Am Vet Med Assoc* (2016) 248:601
- Verstraete FJ, Kass PH, Terpak CH. Diagnostic value of full-mouth radiography in dogs. *J Am Vet Med Assoc* (1998) 59:686-91
- Kim CG, Lee SY, Kim JW, Park HM. Assessment of dental abnormalities by full-mouth radiography in small breed dogs. *J Am Anim Hosp Assoc* (2013) 49:23-30. doi 10.5326/JAAHA-MS-5830
- Stella JL, Bauer AE, Croney CC. A cross-

sectional study to estimate prevalence of periodontal disease in a population of dogs (canies familiaris) in commercial breeding facilities in Indiana and Illinois. *PLoS ONE* (2018) 13:1-13. doi:10.1371/journal.pone.0191395

- Turesky S, Gilmore ND, Glickman I. Reduced plaque formation by the chloromethyl analogue of Vitamin C. *J Periodontol* (1970) 41:41-43. doi: 10.1902/jop. 1970.41.41.41
- Hennet P, Servet E, Salesse H. Evaluation of the Logan and Boyce plaque index for the study of dental plaque accumulation in dogs. *Res Vet Sci* (2006) 80:175-180
- Bonello D, Squarzoni P. Effect of a Mucoadhesive Gel and Dental Scaling on Gingivitis in Dogs. Journal of Veterinary Dentistry. 2008;25(1):28-32. doi:10.1177/089875640802500108