This study was conducted to determine the benefit, if any, of combining antibiotic therapy with ultrasonic scaling, root planing, and polishing (USRP) over USRP alone as determined by improvements in plaque index, gingival index, and pocket depth measurements. Thirty dogs with signs of periodontal disease were randomly assigned to the USRP-only treatment group or to the USRP-antibiotic treatment group. USRP was performed on all dogs on study day 0. In addition, dogs in the USRP-antibiotic treatment group received clindamycin hydrochloride (Antirobe®, Pharmacia & Upjohn, Kalamazoo, MI) dosed at 2.5 mg/lb body weight (BW) twice a day beginning on day 0 and continuing 8 days. Follow-up visits occurred 2, 6, 13, and 25 weeks after the start of the study.

Treatment differences were compared using a mixed model analysis for repeated measures. This analysis indicated that the clindamycin regimen, after USRP, had a significant effect on plaque and pocket depth measures of periodontal disease but not on gingivitis. For plaque, average index scores for the treatment group were lower at all follow-up visits with significant differences at 2 and 6 weeks after cleaning. The antibiotic treatment group also maintained a significantly smaller average pocket depth, representing a 15% postcleaning reduction for the clindamycin group versus a 3% reduction in the control group.

Periodontal disease is a potentially serious condition that threatens all dogs and is among the most common disorders seen in veterinary medicine. In an observational study of 31,484 dogs at private veterinary clinics, 20.5% had dental calculus, 19.5% had gingivitis, and...
2.2% had periodontal disease.¹

Untreated, periodontal disease in the dog is a potentially progressive condition, often beginning with halitosis (oral malodor) as the first detectable sign.² This disease progresses through stages including plaque accumulation, calculus or tartar accumulation, inflammation of the gingiva, periodontal pocket formation, alveolar bone resorption, tooth mobility, and tooth loss.³ The presence and severity of periodontal disease commonly increases with age if no treatment or preventive measures are taken. Currently, the condition is treated by periodic removal of plaque with or without concurrent antibiotic therapy.

In both human and veterinary dentistry, antibiotic therapy is sometimes recommended to help reduce bacteremia and halt the progression of periodontal disease.³⁻⁵ Previous studies have reported an incidence of bacteremia ranging from 30% to 100% for dogs undergoing dental procedures.⁶⁻⁷ In a study of bacterial isolates from plaque and blood, Nieves et al concluded that short-term bacteremia could be expected after routine dental procedures, even in dogs with only mild periodontal disease, and also that patients with renal or cardiac disease or immunosuppression are at risk for developing sequelae to bacteremia.⁷

Most subgingival organisms associated with gingivitis in both dogs and cats have been shown to be aerobic gram-positive (Staphylococcus or Streptococcus species) or anaerobic gram-negative bacteria.⁸⁻⁹ Antimicrobials used to suppress subgingival plaque accumulation should be effective against gram-positive aerobes as well as gram-negative anaerobes, which are the initiators of gingival inflammation and destruction.⁸

Clindamycin hydrochloride has been used in conjunction with dental procedures because it is active against staphylococcal, anaerobic (gram-positive and gram-negative), and polymicrobial dental infections.¹⁰⁻¹¹ Its wide spectrum of activity,¹¹⁻¹² excellent tissue and bone penetration,¹³ and efficacy in purulent environments¹⁴ makes it well-suited for this use.

In the United States, clindamycin is approved for use in treating dental infections caused by susceptible bacteria in both dogs and cats.¹¹ Clindamycin has been shown to have in vitro activity against canine isolates of aerobic gram-positive cocci (Staphylococcus aureus, S. epidermidis, and streptococci except Streptococcus faecalis), anaerobic gram-negative bacilli (Porphyromous, Bacteroides, and Fusobacterium species), anaerobic gram-positive bacilli (Propionibacterium, Eubacterium, and Actinomyces species), anaerobic and microaerophilic gram-positive cocci (Peptococcus and Peptostreptococcus species and microaerophilic streptococci), and most Clostridium perfringens.⁸⁻¹¹

This study was conducted to determine the benefit, if any, of combining antibiotic therapy with ultrasonic scaling, root planing, and polishing (USRP) over USRP alone as determined by improvements in plaque index, gingival index, and pocket depth measurements.

### MATERIALS AND METHODS

**Animals**

Thirty client-owned dogs all from a private veterinary clinic, with Type 2 or Type 3 periodontal disease were enrolled in this study. None of the dogs had any obvious underlying disease, as determined by physical examination, complete blood count, and chemistry profile. Other than the clindamycin administered to the treated animals for the first 8 days of the study, no oral or topical antimicrobials were administered to the test animals during the course of the study. Other medications were not monitored or controlled. Owners of the dogs agreed to cooperate with the investigations required to complete the study over a 6-month period.
Experimental Design

Thirty dogs with early or moderate periodontal disease were randomly assigned, based on a computer-generated randomization schedule, to clindamycin treatment and USRP (treatment, n = 15) or USRP alone (control, n = 15). Dogs in the treatment group were given clindamycin hydrochloride at a dosage of 2.5 mg/lb BW twice a day for 8 days beginning at the initiation of the study. Dogs assigned to the other group served as controls and received USRP only. No other antibiotics or topical antibacterials were used during the course of this study.

A member of the clinic staff assigned treatments and discussed administration with the dog owners; the principal investigator remained blinded throughout the study period. Clindamycin was dispensed according to a standard dosing chart, and a record of drug administration was filled out for each dog. The study procedures and their timing were summarized in a record of visits and treatments. Data were recorded by the clinical investigator.

On initial assignment to the study, each of the following procedures was performed: anesthesia (induction with propofol [Propoflo™, Abbott Labs, Abbott Park, IL], 3 mg/lb BW by IV injection, maintained on isoflurane [AErrane®, Fort Dodge Labs, Ft. Dodge, IA]), full mouth periodontal charting, plaque and gingival indexing, full mouth radiographs, full mouth USRP, and the dispensing of clindamycin for the treated group. On follow-up visits at days 9 to 16, 39 to 45, 87 to 93, and 177 to 183, procedures included sedation (propofol 3 mg/lb BW by IV injection), plaque and gingival indexing, full mouth radiographs, full mouth USRP, and the dispensing of clindamycin for the treated group. On follow-up visits for data collection corresponded approximately to weeks 2, 6, 13, and 25 of the study.

Definitions of Periodontal Disease

The following definitions were used for the classification of periodontal disease:

Periodontal Disease Type 1—Gingivitis: Inflammation of the gingiva characterized by changes in color (red), gingival form, position, surface appearance, and the presence of bleeding and/or exudate. Pocket depth may be minimal (<2 mm).

Periodontal Disease Type 2—Early periodontitis: Progression of the gingival inflammation into the deeper periodontal structures and alveolar bone crest, with slight bone loss. Pocket depths up to 4 mm with slight loss of attachment level. Irreversible but arrestable destruction.

Periodontal Disease Type 3—Moderate to severe periodontitis: Increased destruction of periodontal structures with pocket depths of 4 to 6 mm and beyond. Noticeable loss of bone support with varying degrees of furcation involvement. Tooth mobility is evident.

Study Measures

Plaque Index—URM1, URI1, ULC, LLM1, LLI1, and LRP4 were selected as representative teeth for evaluation. In the event of a missing tooth an alternate tooth was evaluated. Researchers then assigned plaque scores of 0 to 3 to the buccal, lingual, mesial, and distal surfaces of the selected teeth according to the following criteria.

0 = Gingival area of tooth is free of plaque; the surface is tested by running a probe across the tooth surface; if no soft material adheres, the area is considered plaque-free.
1 = No plaque is observed in situ by the unaided eye, but plaque is visible on the
point of a probe after the probe has been moved over the tooth surface at the entrance of the gingival crevice.

2 = Gingival area is covered by a thin to moderately thick layer of plaque visible to the naked eye.

3 = Heavy accumulation of soft matter, the thickness of which fills the crevice produced by the gingival margin and the tooth surface.

**Gingival Index**—Investigators assigned gingival scores of 0 to 3 to buccal, lingual, mesial, and distal areas of the same teeth selected for the plaque index. Scores for the four areas were added and then divided by four to equal the gingival index for a tooth. Then scores for all the examined teeth were added and divided by the number of teeth to give the gingival index for the mouth.

Scores were assigned according to the following criteria:

0 = Absence of inflammation.

1 = Mild inflammation; slight change in color and little change in texture; no bleeding on probing.

2 = Moderate inflammation; moderate glazing, redness, edema and hypertrophy; bleeding on probing.

3 = Severe inflammation; marked redness and hypertrophy; tendency for spontaneous bleeding; ulceration.

**Pocket Depth**—Pocket depth was measured in millimeters (mm) with a calibrated dental probe along the lingual and buccal margins of the three teeth with the deepest pockets. Scores for the three sites were averaged to produce mean pocket depth.

**Anesthesia**

Dogs were sedated or induced with propofol at a dose of 3 mg/lb BW administered intravenously. General anesthesia was maintained with isoflurane.

**Ultrasonic Scaling, Root Planing, and Polishing (USRP)**

Ultrasonic scaling was done both supragingivally and subgingivally with a magnetostrictive scaler. The technique used the lateral edge of the thin tip, beginning the stroke at the gingival margin. Vibrations broke the deposit and dislodged it from the tooth surface. Ultrasonic scaling was performed with light pressure, and the tip was moved over every square millimeter of the root surface to remove bacteria, plaque, and calculus.

**Data Collection**

For each dog, plaque and gingivitis scores were recorded before USRP (week 0) and at four additional times after USRP (approximately weeks 2, 6, 13, and 25). For plaque and gingivitis, index scores were assessed for the four surfaces on each of the six selected teeth. At each time period, these scores were averaged by tooth and then by dog to provide overall plaque and gingivitis index scores for the mouth of each dog. For pocket depth, the depth at three sites was measured and averaged to represent the mean pocket depth for the mouth. These measures of plaque, gingivitis, and pocket depth served as the primary decision variables for this analysis.

**Statistical Analysis**

All analyses were performed using PROC MIXED and PROC GLM of the SAS statistical software package.\(^\text{15}\) To better satisfy model assumptions of normality and equal variances, a square-root transformation was used for testing and reporting \(P\) values.\(^\text{16}\) Measurements collected at the time of enrollment (week 0) provided an indication of baseline levels. Al-
though the USRP would reduce or eliminate pretreatment differences between the treatment and control groups, week 0 data were used as covariates to partially account for differences in dental hygiene during the remainder of the study.

The treatment differences for the follow-up periods were first compared using a mixed-model analysis of variance for repeated measures. If the treatment and time period effects were both significant (F test, \( P < .05 \)), treatment comparisons were made separately for each follow-up visit (two-sample t-test). If the treatment effect was significant, but the time period effect was not significant, the observations were averaged for a single posttreatment comparison of the treatment effect.

### RESULTS

Because of lack of owner compliance, seven dogs did not return for all follow-up appointments. Procedures for missing values and weighted analyses were used, when appropriate, for dogs withdrawn before completion of the study.

Results of the repeated measures analyses are summarized in Table 1. The significance of the covariate for all three measures \( (P < .01) \) indicates a strong association with the respective week 0 measurements. A treatment effect was evident in plaque scores \( (P = .05) \) and pocket depth \( (P = .03) \) but not in gingivitis scores \( (P = .63) \). Both plaque and gingivitis had significant time period effects \( (P < .01 \) and \( P = .02, \) respectively), but a period effect was not significant for pocket depth \( (P = .21) \).

#### Plaque

With treatment and time period effects both significant, week-by-week comparison of mean scores in Table 2 indicates that the clindamycin group had lower plaque scores at each follow-up visit with significantly lower scores at weeks 2 and 6 \( (P < .01 \) and \( P = .04, \) respectively). Mean plaque scores for both groups increased with each subsequent follow-up visit. These results are illustrated in Figure 1 with the initial decrease between week 0 and week 2 caused in part by the USRP performed on all of the dogs.

#### Gingivitis

Although there was a significant time period effect, lack of a significant treatment effect indicates that there was little difference between the two groups. Figure 2 illustrates that, after USRP, both groups experienced a similar increase in mean gingivitis score at each follow-up visit.

#### Pocket Depth

With no significant evidence of a period effect for pocket depth (Figure 3), data for weeks 2, 6, 13, and 25 were combined for an overall follow-up visit average. The test for treatment difference in Table 2 indicates that the average

### TABLE 1. \( P \) values for Tests of Treatment and Time Period Effects using Mixed Model Analysis for Repeated Measures

<table>
<thead>
<tr>
<th>Source</th>
<th>Plaque Index</th>
<th>Gingivitis Index</th>
<th>Pocket Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 0 (covariate)</td>
<td>( &lt; .01 )</td>
<td>( &lt; .01 )</td>
<td>( &lt; .01 )</td>
</tr>
<tr>
<td>Treatment</td>
<td>( .05 )</td>
<td>( .63 )</td>
<td>( .03 )</td>
</tr>
<tr>
<td>Time Period</td>
<td>( &lt; .01 )</td>
<td>( .02 )</td>
<td>( .21 )</td>
</tr>
<tr>
<td>Time Period ( \times ) Treatment</td>
<td>( .38 )</td>
<td>( .67 )</td>
<td>( .53 )</td>
</tr>
</tbody>
</table>
pocket depth was significantly smaller in the treatment group than in the control group ($P = .04$). This difference represented, on average, a 15% postcleaning reduction in pocket depth for the clindamycin group compared with a 3% reduction in the control group.

### DISCUSSION

This study evaluated the results of USRP with and without antimicrobial therapy on three measures of periodontal disease: plaque, gingivitis, and pocket depth. An 8-day regimen of clindamycin treatment was beneficial in significantly reducing recurrence of plaque formation for 6 weeks after ultrasonic scaling and produced a sustained decrease in pocket depth throughout the 25-week observation period. There was no statistically significant impact of the treatment on gingivitis.

<table>
<thead>
<tr>
<th>TABLE 2. Least Squares Treatment Means for Plaque Scores and Pocket Depth (mean values adjusted for week 0 measurements)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Least Squares Means (SE)</strong></td>
</tr>
<tr>
<td><strong>Clindamycin</strong></td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td><strong>Plaque Score</strong></td>
</tr>
<tr>
<td>Week 2</td>
</tr>
<tr>
<td>Week 6</td>
</tr>
<tr>
<td>Week 13</td>
</tr>
<tr>
<td>Week 25</td>
</tr>
<tr>
<td><strong>Pocket Depth (mm)</strong></td>
</tr>
<tr>
<td>Posttreatment Avg.</td>
</tr>
</tbody>
</table>

*P value for the one-sided test for a difference in means is based on square root transformation.

Figure 1. Mean plaque index scores in both groups increased at each visit after study initiation. The clindamycin group had significantly lower mean scores at weeks 2 and 6 ($P < .01$ and $P = .04$ respectively).

Figure 2. After ultrasonic scaling, there was little difference between the mean gingivitis index scores for the two groups during the study.
In light of the significant improvement in plaque scores and peridontal pocket scores, lack of a statistically significant improvement in gingivitis scores deserves further comment. One can only speculate, but a plausible explanation might be that all components of the multifaceted diseases represented in this study do not advance or retreat at the same rate. Support for this explanation might be the fact that calculus and plaque scores are not necessarily predictive of gingivitis scores; hence the appropriateness of scoring each of these variables separately. Another explanation might be that monitoring the patients at more frequent intervals in early stages after treatment may have detected an improvement in gingivitis scores for the clindamycin group compared with a 2.6% reduction for the control group.

In a study of the effects of subgingival administration of doxycycline for periodontal disease, pocket depths were significantly reduced in all treated teeth compared with controls throughout the 6-month study ($P < 0.05$).

Figure 3. Pocket depth decreased initially in both groups, but the clindamycin group had a significantly lower average pocket depth than the control group ($P = .04$). This difference represented a 15% postcleaning reduction for the clindamycin group compared with a 2.6% reduction for the control group.

Later studies showed clindamycin given 5 days before ultrasonic scaling benefits the patient by reducing plaque bacteria by 97.6%. This lowers the level of bacteria that could be involved in the bacteremia that often occurs with-

...
Antimicrobial treatment provided substantial and sustained benefit in reducing pocket depth compared with prophylaxis alone. Efficacy in more advanced disease is likely to be caused by control of colonized microorganisms responsible for polymicrobial dental infections. Attachment gains, such as those documented in the doxycycline study, suggest that antimicrobial treatment may reverse the progression of periodontitis and underscore the importance of early intervention.

Current study results are consistent with results from clinical trials of clindamycin used to treat human dental infections. Gordon et al conducted a study of 30 human patients with a history of unsuccessful treatment of periodontal disease, including scaling, periodontal surgery, and the use of tetracyclines. These patients underwent scaling and were then monitored for the presence of active disease by duplicate measurements of attachment levels. Active disease was defined as an increase over baseline of ≥3 mm in pocket depth. When active disease was detected, patients were treated with scaling and clindamycin 150 mg four times a day for 7 days. Patients served as their own controls. Scaling plus clindamycin treatment significantly decreased the incidence of active disease from an annual rate of 8.0% to 0.5% sites per patient \((P < .001)\) compared with scaling alone. Combined scaling and clindamycin treatment also significantly increased the mean time to detect active disease \((P < .001)\) and significantly reduced bleeding on probing \((P < .05)\) compared with scaling alone.

**CONCLUSION**

Because plaque is a product of bacterial activity and recurring plaque accumulation is considered a precursor of calculus, delaying the deposition of plaque on the tooth surfaces would logically be expected to prolong the interval between required USRP and contribute to the good general oral health of the patient. The clinical significance of pocket depth reduction observed in animals treated with clindamycin would depend on the pocket depth before treatment. Because untreated periodontal pockets tend to become deeper and pocket depth is considered prognostic in initiating a treatment plan, stabilizing or reducing pocket depth can have real consequences for the future of the tooth. Further research would be required to determine if repeated periodic USRP with a course of clindamycin therapy would result in an additive benefit of continued, additional pocket depth reduction.

**REFERENCES**