RESEARCH ARTICLE

Periodontal Disease in Dogs: Incidence and Comparative Efficacy of Ozonated Water versus Demineralized Water in Dental Scaling

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Abstract

A retrospective study of 6,141 canine cases presented to the Veterinary Clinical Complex, Kamdhenu University, Anand (August 2023 to July 2024), identified 87 (1.42%) cases with oral affections. Of these, 21 (24.13%) were diagnosed with periodontal disease. Higher incidence was noted in male and older dogs, the most affected breeds being Labrador Retrievers, German Shepherds, and Pomeranian Spitz. Dogs on soft or vegetarian diets without oral hygiene showed increased susceptibility. Clinically, halitosis, abnormal salivation, dental plaque, and calculus were the predominant findings. In a therapeutic trial with 14 affected dogs, two groups of seven received ultrasonic dental scaling with either ozonated or demineralized water. Gram-positive cocci were the predominant isolates from dental swabs, and Amikacin showed the highest antibiotic sensitivity (71.42%). Scaling with ozonated water reduced bacterial load significantly (from $74.14 \pm 8.13 \times 10^3$ to $32.57 \pm 4.77 \times 10^3$ CFU/mL; $p = 0.001$), whereas demineralized water produced no significant change ($79.86 \pm 8.43 \times 10^3$ to $70.00 \pm 7.61 \times 10^3$ CFU/mL; $p = 0.064$). These findings underscore the high incidence of periodontal disease in specific canine demographics and demonstrate the superior antibacterial efficacy of ozonated water in canine periodontal disease management through dental scaling. These findings suggest that ozonated water is more effective for bacterial control in periodontal lesions.

Key words: Bacterial load, Canine, Dental scaling, Incidence, Ozonated water, Periodontal disease.

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Introduction

Oral health is vital for companion animals, with dental and periodontal diseases among the most common conditions observed in dogs (Niemiec, 2008; Fadden and Marretta, 2013). Periodontal disease begins with plaque formation, progressing to calculus, gingivitis, and ultimately periodontitis, which involves periodontal ligament and alveolar bone destruction (Harvey, 2005; Gorrel, 2013). Periodontitis is a more severe disease that involves inflammation of the periodontal ligament and alveolar bone, eventually causing loss of attachment, periodontal pocketing, gingival recession, bone resorption and furcation defect (Harvey, 2005). The majority of illnesses, such as dental caries, dental calculus, periapical abscesses and deep-seated lesions associated with chronic periodontitis, are identified when there is foul breath, considerable pain, or bleeding from the mouth (Listgarten and Ellegard, 1973). Clinical manifestations include halitosis, salivation, gingival recession, mobility, and tooth loss (Rawlinson, 2003).

Studies suggest that by two years of age, nearly 80% of dogs exhibit some form of periodontal disease (Martin *et al*., 2011; Zambori *et al*., 2012). Risk factors include breed predisposition, sex, age, diet, and lack of oral hygiene practices. Smaller breeds often show higher susceptibility due to genetic predisposition and malocclusions (Butkovic *et al*., 2001). However, data from different regions vary, and epidemiological studies are necessary for better preventive care planning. Eisner (1989) suggested including rawhide chew toys and bones in a dog's diet to promote healthy gum exercise and aid in the efficient removal of plaque from the corners of the teeth.

Management of periodontal disease traditionally involves mechanical scaling and antibiotics. However, the rise of antimicrobial resistance highlights the need for alternative therapies. Ozone (O_3), a triatomic oxygen molecule, has shown strong antimicrobial, immunomodulatory, and anti-inflammatory properties (Seidler *et al*., 2008; Srikanth *et al*., 2013). Ozonated water has been reported to significantly reduce bacterial load in periodontal lesions (Ramzy *et al*., 2005; Saini, 2011). This study was therefore focused

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on retrospectively analysis of the clinical incidence of periodontal disease in dogs with respect to age, sex and breed, and to compare the efficacy of ozonated water versus demineralized water in dental scaling.

Materials and Methods

The present study on incidence of periodontal disease was conducted using case records of 6,141 dogs presented to the Veterinary Clinical Complex, College of Veterinary Science and Animal Husbandry, Kamdhenu University, Anand (Gujarat) during the period from August 2023 to July 2024. All the cases were subjected to detailed anamnesis and signalment. Dogs above one year of age that were brought with oral affections such as halitosis, pawing at the mouth, salivation, facial swelling, sneezing, or ocular changes were carefully screened. The details of the cases about age, breed, sex, feeding habits, chief complaint, home dental care, use of dental chews, previous history of dental affections and the treatment followed were collected from the owner and recorded. Out of 6141 dogs, 87 were found to have oral disorders, and 21 of them were diagnosed with periodontal disease. The incidence was calculated with respect to sex, breed, age, feeding habits, and the nature of the presenting complaints.

For the therapeutic trial, a total of 14 dogs clinically diagnosed with periodontal disease were selected and randomly divided into two equal groups of seven animals each. Sterile cotton swabs were used to collect samples from the gingival sulcus before and immediately after scaling. Dogs in Group I (n=7) were subjected to ultrasonic dental scaling using ozonated water, while those in Group II (n=7) underwent ultrasonic scaling with demineralized water. The swab samples were processed for bacterial culture and identification, and the isolates were further subjected to antibiotic sensitivity testing by the disc diffusion method. In addition, bacterial load was estimated in terms of colony-forming units per milliliter (CFU/mL).

Data generated were analyzed statistically using paired and independent t-tests, with a probability level of $p<0.05$ considered significant.

Results and Discussion

Out of a total of 6141 canine cases presented during the study period, 87 cases (1.42%) were found to have oral affections, of which 21 cases (24.13%) were diagnosed as periodontal disease. This current incidence of periodontal disease was quite lower than that of Vani *et al.* (2007), who reported the overall occurrence of dental diseases as 48.73%, of which 53.17% of canine cases were having the disease of tooth substance. Zambori *et al.* (2012), and Fadden and Marretta (2013), further mentioned that 80% of the dogs included in their study were having periodontal disease. The incidence was higher in male dogs (66.67%, 14/21) compared to female dogs (33.33%) under study, which was in agreement with the findings of Vani *et al.* (2007) and Kumar *et al.* (2008). However, contrary to this, Martin *et al.* (2011) and Archana (2009) reported higher incidence in female dogs.

Breed-wise distribution revealed that out of 21 affected dogs, Labrador Retrievers showed the highest prevalence (28.57%, 6), followed by German Shepherds (23.80%, 5), Pomeranians (19.04%, 4), Doberman (14.28%, 3), Pug (9.52%, 2) and Beagle (4.76%, 1) (Fig. 1). The present findings aligned with those of Pai (2018), who reported a higher incidence of periodontal disease in Labrador Retrievers, which however, contradict the results of Martin *et al.* (2011), who observed the highest incidence in German Shepherds. Smaller breeds such

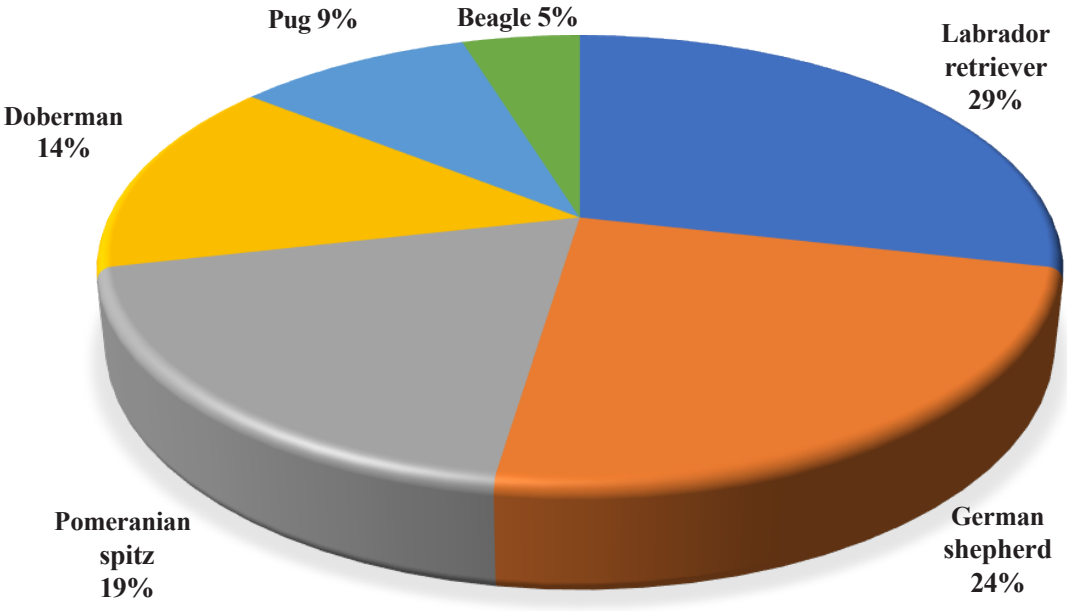

Fig. 1: Graphical representation of breed-wise incidence of periodontal disease in dogs

as Pomeranians exhibited a notable incidence, which supports earlier observations of Butkovic *et al*. (2001) that toy breeds are more susceptible to periodontal disease. Sisodiya (2005) and Aswathy *et al*. (2019) also reported a greater prevalence of periodontal disease in smaller dog breeds compared to larger breeds probably be due to their longer life expectancy and genetic predisposition causing malocclusions in gingiva, thus exposing the teeth to deposition of sub gingival plaque resulting in periodontal disease.

Age-wise analysis indicated that dogs above eight years of age had the highest incidence (56%), followed by those of 4-8 years (30%) and below 4 years (15%), reflecting the chronic and progressive nature of the disease. These findings were consistent with those of Lyon (2000), Martin *et al*. (2011) and Pai (2018), who reported a higher incidence of periodontal disease in dogs aged 5-8 years followed by those aged 1-4 years and aged 9-12 years. Feeding habits and oral hygiene were also found to influence disease occurrence, as dogs maintained on soft or vegetarian diets without proper dental care were more prone to periodontal disease. The most common presenting complaints were halitosis and abnormal salivation, while oral examination revealed dental plaque and calculus as the predominant clinical findings.

Bacteriological examination of gingival sulcus swabs revealed that Gram-positive cocci (50.00%) were the most predominant isolates, followed by Gram-negative bacilli (28.58%) and coccobacilli (21.42%). These findings were consistent with those reported by Syed (1980) and Sarkiala *et al*. (1993). Mithun (2017) conducted a study on the bacteriological culture isolation of mineralized dental plaque swabs and also revealed the presence of different types of bacterial colonies, viz., *Streptococcus* spp. (40%), *Staphylococcus* spp. (30%) and *Escherichia* spp. (20%). Antibiotic sensitivity testing showed that Amikacin exhibited the highest efficacy (71.42%), followed by Amoxicillin with Clavulanate (57.14%), and Gentamicin and Chloramphenicol (50.00% each), Tetracycline (42.28 %), Ceftriaxone (21.42%), and Enrofloxacin showed the lowest sensitivity (14.28%) (Table 1). Archana (2009) reported Gram-positive cocci exhibiting sensitivity to amoxicillin, ampicillin, enrofloxacin, ciprofloxacin, gentamicin, doxycycline and cefotaxime but showed resistance to chloramphenicol, and Gram-negative coccobacillary organisms were susceptible to ciprofloxacin, enrofloxacin, cefotaxime, gentamicin and chloramphenicol yet resistant to sulphadiazine. These patterns however differed from earlier studies (Sisodiya, 2005; Mithun, 2017), indicating possible regional differences in diet and bacterial resistance.

Bacterial load estimation revealed that dogs in Group I (ultrasonic scaling with ozonated water) showed a significant reduction post-treatment in colony-forming units, from $74.14 \pm 8.13 \times 10^3$ to $32.57 \pm 4.77 \times 10^3$ CFU/mL ($p=0.001$). In contrast, dogs in Group II (scaling with demineralized water) exhibited only a non-significant reduction, from $79.86 \pm 8.43 \times 10^3$ to $70.00 \pm 7.61 \times 10^3$ CFU/mL ($p=0.064$). Post-treatment bacterial counts were significantly lower in Group I compared to Group II ($p=0.001$), though it was at par in two groups before treatment. The findings of this study suggested that dental scaling using ozonated water was more effective in reducing bacterial load counts as compared to dental scaling using demineralized water. These findings corroborated with the results of Nagayoshi *et al*. (2004) and Ramzy *et al*. (2005), who demonstrated the antibacterial potential of ozone in reducing oral microbial load.

Ozone exerts its therapeutic effects through several mechanisms. Firstly, ozone has potent antimicrobial properties, effectively killing bacteria, viruses and fungi that are responsible for periodontal infections. Additionally, it stimulates the body's natural immune response by increasing the production of white blood cells and cytokines, aiding in the removal of infected tissue and promoting tissue healing. Ozone therapy also enhances oxygen delivery to the periodontal tissues, promoting improved circulation and tissue oxygenation, which aids in tissue regeneration and repair. Furthermore, ozone therapy reduces inflammation and pain, contributing to the overall improvement of periodontal

Table 1: Antibiotics sensitivity pattern of dental swab samples (n = 14)

Antibiotics	**No. sensitive**	Percent	Sensitive for organism
Amikacin (30 mcg)	10	71.42	Gram-positive cocci Gram-negative bacilli
Amoxicillin (30 mcg) + Clavulanate (10 mcg)	8	57.14	Gram-positive cocci Gram-negative bacilli Gram-negative cocco-bacilli
Gentamicin (10 mcg)	7	50.00	Gram positive cocci Gram-negative bacilli Gram-negative cocco-bacilli
Chloramphenicol (30 mcg)	7	50.00	Gram-positive cocci Gram-negative bacilli Gram-negative cocco-bacilli
Tetracycline (30 mcg)	6	42.28	Gram-positive cocci Gram-negative bacilli
Ceftriaxone (30 mcg)	3	21.42	Gram-positive cocci Gram-negative bacilli
Enrofloxacin (10 mcg)	2	14.28	Gram-negative bacilli

health. Ozone has been shown to possess unique properties and has potential applications to the clinical practice of dentistry and medicine. The present study thus highlights the superior efficacy of ozonated water as an adjunct in ultrasonic scaling for the management of periodontal disease in dogs. Significant antibacterial properties of ozonated water, particularly in killing both Gram-positive and Gram-negative bacteria were also reported by Nagayoshi *et al*. (2004), Pattanaik *et al*. (2011) and Srikanth *et al*. (2013).

Conclusion

The finding of present study in general revealed higher incidence of periodontal disease in male dogs, particularly in older and adult age groups, and those maintained on pure vegetarian or soft diets without proper oral hygiene practices, with Labrador Retrievers showing the highest prevalence. Among affected dogs halitosis, abnormal salivation, dental plaque and dental calculus were the most common clinical signs and symptoms. Further, Gram-positive cocci were the predominant pathological bacteria identified from the gingival sulcus dental swab of canines and Amikacin was the most sensitive than other antibiotics. Dental scaling using ozonated water was more effective in reducing bacterial load as compared to dental scaling using demineralized water. Overall study demonstrated the superior antibacterial efficacy of ozonated water in canine periodontal disease management through dental scaling and hence may be used in routine clinical practice.

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