

Comparative Evaluation of Silver Nanoparticles Gel and Metronidazole Gel with Dental Scaling in Dogs

Rajeshwary Patel^{1*}, Atul Singh Parihar¹, Rakhi Gangil², Pavan Diwan Singh Raghuvanshi¹, Nidhi Shrivastava³

ABSTRACT

Periodontal disease is one of the most prevalent clinical conditions in dogs, primarily resulting from plaque accumulation and subsequent gingival inflammation. Mechanical debridement through scaling and polishing is considered the standard therapeutic approach; however, adjunct antimicrobial therapy may enhance clinical outcomes. The present study evaluated and compared the efficacy of topical silver nanoparticles gel and metronidazole gel following ultrasonic scaling and polishing in dogs with dental affections. 18 clinical cases were randomly divided into 3 groups (n=6 each), and received scaling and polishing with systemic amoxicillin-clavulanate in group I; topical metronidazole gel in group II, and topical silver nanoparticles gel in group III. Clinical, microbial load, haematological and biochemical parameters were assessed on day 0, 7 and 14. Significant reductions ($p < 0.05$) in plaque score, gingivitis score, halitosis, microbial load and total leukocyte counts were observed in all groups. Other haematological and biochemical parameters showed non-significant changes. The study concludes that silver nanoparticle gel and metronidazole gel are effective adjuncts to scaling and polishing, with silver nanoparticles demonstrating slightly superior antimicrobial efficacy.

Key words: Canine, Dental scaling, Metronidazole, Periodontal disease, Silver nanoparticles.

Ind J Vet Sci and Biotech (2026); 10.48165/ijvsbt.22.4.26

INTRODUCTION

Periodontal disease in dogs is initiated by dental plaque, a biofilm composed of microorganisms embedded in salivary glycoproteins and extracellular polysaccharides (Perazzi *et al.*, 2022). If untreated, plaque mineralizes into calculus and triggers gingivitis, potentially progressing to periodontitis (Ubertalli, 2024). Clinical signs include halitosis, hypersalivation, gingival bleeding and reduced appetite. Dental prophylaxis involves scaling to remove plaque and calculus, followed by polishing to smooth enamel surfaces and reduce reattachment (Fichtel *et al.*, 2008; Pai, 2018). However, mechanical therapy alone may not fully eliminate subgingival pathogens. Metronidazole is widely used against anaerobic organisms and acts by disrupting microbial DNA (Sandhu, 2023). Silver nanoparticles (AgNPs), due to their high surface area and membrane penetrating ability, demonstrate broad spectrum antimicrobial activity (Dai *et al.*, 2016; Fakhrudin *et al.*, 2020). Their ion release disrupts bacterial membranes and replication mechanisms (Xu *et al.*, 2024). This study aimed to compare the clinical efficacy of silver nanoparticles gel and metronidazole gel as adjuncts to dental scaling and polishing in dogs.

MATERIALS AND METHODS

The present work was carried out in the Department of Veterinary Surgery and Radiology, College of Veterinary Science and Animal Husbandry, Mhow (MP, India). Total 18

¹Department of Veterinary Surgery and Radiology, College of Veterinary Science and Animal Husbandry, Mhow-453441, NDVSU, MP, India

²Department of Veterinary Microbiology, College of Veterinary Science and Animal Husbandry, Mhow- 453441, NDVSU, MP, India

³Department of Veterinary Pathology, College of Veterinary Science and Animal Husbandry, Mhow- 453441, NDVSU, MP, India

Corresponding Author: Dr. Rajeshwary Patel, Department of Veterinary Surgery and Radiology, College of Veterinary Science and Animal Husbandry, Mhow-453441, NDVSU, MP, India. e-mail: bulbulrajeshwary@gmail.com

How to cite this article: Patel, R., Parihar, A. S., Gangil, R., Raghuvanshi, P. D. S., & Shrivastava, N. (2026). Comparative Evaluation of Silver Nanoparticles Gel and Metronidazole Gel with Dental Scaling in Dogs. *Ind J Vet Sci and Biotech*, 22(4), 140-142.

Source of support: Nil

Conflict of interest: None

Submitted 18/03/2026 **Accepted** 07/04/2026 **Published** 10/07/2026

dogs with plaque accumulation, gingivitis, halitosis, and related signs were randomly assigned into 3 groups and each group had 6 animals. All the animals were selected irrespective of age, sex and breed. Group I received scaling and polishing with systemic amoxicillin-clavulanate @ 13.75 mg/kg b.wt. orally twice daily for 5 days. In group II, ultrasonic scaling and polishing was performed on the affected teeth followed by topical application of metronidazole gel daily for 7 days. In group III, ultrasonic

scaling and polishing was performed on the affected teeth followed by topical application of silver nanoparticles gel daily for 7 days.

Clinical Parameters: The clinical observations like dental plaque, gingivitis, halitosis and difficulty in eating were recorded on 0, 7th and 14th day. All the animals were screened for visible plaque deposition on the tooth surface and scoring was done as described by Clarke *et al.* (2011) with slight modification. Total visible tooth surface area (mesial, buccal, labial, lingual and distal) covered by plaque were taken into consideration for the scoring pattern. The severity of gingivitis was measured on the basis of visible changes in the gingiva with slight modification given by Quest (2013). The total surface area affected and reddening of the mucosa was assessed. Clinical signs such as halitosis, difficulty in eating were observed as described by Bhatnagar (2023).

Microbial Evaluation: The samples from the tooth surface were collected aseptically, followed by the removal of dental plaque. A sterile cotton swab moistened with sterile saline, was then used to rub along the gum tooth junction to gather the plaque sample. Samples were collected on 0, 7th and 14th day. Microbial load was assessed using standard plate count and expressed as colony forming unit (Marth, 1978).

Haemato-Biochemical Parameters: Cephalic blood samples (2 mL in heparinized vacutainers and 1 mL in serum clot activator tubes) were collected from all dogs before dental scaling and polishing, and on 7th day and 14th day of treatment for haemato-biochemical analysis.

The data was analyzed statistically by using a two way analysis of variance as per Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

Significant reduction in halitosis ($p < 0.05$) occurred in all groups. Groups II and III showed complete resolution by day 14 (Table 1). The pattern of decrease in eating problems and appetite in dogs showed non-significant differences on 7th day and 14th day in all the three groups.

In present study, plaque deposition score ($p < 0.05$) reduced significantly in all the three groups, while in group II and group III the reoccurrence of plaque was absent during observation period, which could be attributed to the administration of topical application of metronidazole gel and silver nanoparticles gel, respectively, showing an impressive effect in dental hygiene. Mechanical scaling effectively reduces plaque (Adepu *et al.*, 2018; Pai, 2018). Significant improvement was also seen in gingivitis ($p < 0.05$) in all groups, with greater reduction in groups II and III (Table 1).

Significant reduction was observed in microbial load in dental swabs from Groups II and III by day 14 ($p < 0.05$), with greatest reduction in Group III, which showed the lowest microbial load on day 14. Total leukocyte counts also decreased significantly in Groups II and III by day 14 ($p < 0.05$; Table 1). However, adjunct antimicrobials enhance subgingival pathogen control. Metronidazole is effective against anaerobes such as *Porphyromonas* spp. (Heijl and Lindhe, 1982). The superior reduction in microbial load observed in Group III supports these findings. Haemoglobin, PCV, and TEC increased non-significantly within normal limits (Table 2). Haematological improvements aligned with previous studies reporting reduced systemic inflammatory markers following periodontal therapy (Polkowska *et al.*, 2014; Praveen, 2016). The BUN, serum creatinine, AST

Table 1: Mean values ($\pm$ SE) of different parameters of dogs under three treatment groups at different time intervals

Parameters	Groups	Days of treatment		
		0	7	14
Halitosis score	I	0.83 ^{Aa} $\pm$ 0.16	0.33 ^{Ab} $\pm$ 0.21	0.16 ^{Ab} $\pm$ 0.16
	II	1.00 ^{Aa} $\pm$ 0.00	0.16 ^{Ab} $\pm$ 0.16	0.00 ^{Ab} $\pm$ 0.00
	III	1.00 ^{Aa} $\pm$ 0.00	0.16 ^{Ab} $\pm$ 0.16	0.00 ^{Ab} $\pm$ 0.00
Plaque deposition score	I	2.66 ^{Aa} $\pm$ 0.42	0.00 ^{Ab} $\pm$ 0.00	0.16 ^{Ab} $\pm$ 0.16
	II	2.50 ^{Aa} $\pm$ 0.42	0.00 ^{Ab} $\pm$ 0.00	0.00 ^{Ab} $\pm$ 0.00
	III	2.33 ^{Aa} $\pm$ 0.33	0.00 ^{Ab} $\pm$ 0.00	0.00 ^{Ab} $\pm$ 0.00
Gingivitis score	I	2.00 ^{Aa} $\pm$ 0.36	1.50 ^{Aa} $\pm$ 0.34	0.33 ^{Ab} $\pm$ 0.21
	II	2.50 ^{Aa} $\pm$ 0.22	1.00 ^{Ab} $\pm$ 0.25	0.16 ^{Ac} $\pm$ 0.16
	III	2.16 ^{Aa} $\pm$ 0.30	0.83 ^{Ab} $\pm$ 0.30	0.16 ^{Ab} $\pm$ 0.16
Microbial load ($\times 10^6$ CFU/mL)	I	25.73 ^{Aa} $\pm$ 1.46	29.85 ^{Aa} $\pm$ 7.45	22.82 ^{Aa} $\pm$ 6.35
	II	14.83 ^{Aa} $\pm$ 1.42	10.62 ^{Aab} $\pm$ 2.38	8.52 ^{Aab} $\pm$ 3.00
	III	11.28 ^{Aa} $\pm$ 0.80	7.40 ^{Ab} $\pm$ 1.86	6.06 ^{Ab} $\pm$ 2.14
Total leucocyte count (thousand/ μ L)	I	21.93 ^{Aa} $\pm$ 1.64	23.42 ^{Aa} $\pm$ 1.55	22.33 ^{Aa} $\pm$ 1.94
	II	21.32 ^{Aa} $\pm$ 1.27	21.93 ^{Aab} $\pm$ 1.25	19.71 ^{Aab} $\pm$ 1.61
	III	19.76 ^{Aa} $\pm$ 1.03	18.70 ^{Ab} $\pm$ 1.31	17.41 ^{Ab} $\pm$ 1.53

Gp=I, scaling and polishing with systemic amoxicillin-clavulanate, Gp=II, scaling and polishing followed by topical metronidazole gel, Gp=III, scaling and polishing followed by topical silver nanoparticle gel. Means bearing different superscripts within the row (a,b) and within column (A,B) differ significantly ($p < 0.05$).

showed a non-significant decreasing trend, while ALT showed an increasing trend in all three groups within normal range (Table 2).

Table 2: Mean ($\pm$ SE) values of haemato-biochemical of dogs under three treatment groups at different time intervals

Parameters	Groups	Days of treatment		
		0	7	14
Haemoglobin (g/dL)	I	12.87 $\pm$ 0.47	12.31 $\pm$ 0.72	12.38 $\pm$ 0.52
	II	13.51 $\pm$ 0.56	13.17 $\pm$ 0.52	13.39 $\pm$ 0.47
	III	13.89 $\pm$ 0.47	13.55 $\pm$ 0.56	13.96 $\pm$ 0.31
PCV (%)	I	38.08 $\pm$ 1.39	39.00 $\pm$ 1.41	38.29 $\pm$ 1.51
	II	40.19 $\pm$ 1.63	41.18 $\pm$ 1.73	41.01 $\pm$ 1.34
	III	41.24 $\pm$ 1.62	42.26 $\pm$ 1.31	42.73 $\pm$ 1.00
TEC ($\times 10^6/\mu$ L)	I	6.12 $\pm$ 0.33	5.95 $\pm$ 0.34	5.98 $\pm$ 0.39
	II	6.33 $\pm$ 0.33	6.31 $\pm$ 0.37	6.40 $\pm$ 0.32
	III	6.75 $\pm$ 0.27	6.70 $\pm$ 0.32	6.86 $\pm$ 0.18
BUN (mg/dL)	I	21.93 $\pm$ 1.64	23.42 $\pm$ 1.55	22.33 $\pm$ 1.94
	II	21.32 $\pm$ 1.27	22.10 $\pm$ 1.21	20.04 $\pm$ 1.53
	III	19.76 $\pm$ 1.03	19.53 $\pm$ 0.99	18.25 $\pm$ 1.34
Creatinine (mg/dL)	I	1.14 $\pm$ 0.06	1.04 $\pm$ 0.14	1.16 $\pm$ 0.05
	II	1.07 $\pm$ 0.06	1.00 $\pm$ 0.11	1.03 $\pm$ 0.08
	III	0.97 $\pm$ 0.05	0.91 $\pm$ 0.03	0.92 $\pm$ 0.09
AST (IU/L)	I	47.07 $\pm$ 7.7	46.09 $\pm$ 6.01	51.56 $\pm$ 6.01
	II	43.95 $\pm$ 5.18	38.59 $\pm$ 3.27	43.41 $\pm$ 4.74
	III	39.63 $\pm$ 2.39	33.17 $\pm$ 1.50	37.61 $\pm$ 4.08
ALT (IU/L)	I	34.64 $\pm$ 2.87	28.95 $\pm$ 2.18	34.94 $\pm$ 2.30
	II	36.60 $\pm$ 2.95	33.83 $\pm$ 1.62	40.11 $\pm$ 2.12
	III	38.16 $\pm$ 2.63	36.52 $\pm$ 2.27	42.96 $\pm$ 2.28

None of the parameters differ significantly between periods or between groups ($p > 0.05$).

In brief, both metronidazole gel and silver nanoparticle gel significantly enhanced the efficacy of dental scaling and polishing in dogs. Silver nanoparticle gel demonstrated greater microbial reduction, no plaque reoccurrence, faster gingivitis resolution. Thus, silver nanoparticles may serve as a promising adjunct in canine periodontal therapy.

ACKNOWLEDGEMENT

The authors express their sincere gratitude to the College of Veterinary Science and Animal Husbandry, Mhow, for providing the necessary facilities to carry out this research.

REFERENCES

Adepu, R., Raghavender, K.B.P., Kumar, V.G., & Ramesh, N. (2018). A clinical study on the incidence of periodontal diseases in dogs and their surgical management. *The Pharma Innovation Journal*, 7(4), 290-292.

Bhatnagar, A. (2023). Clinical efficacy of dental scaling and polishing to prevent the formation of plaque and gingivitis with or without Metronidazole-Spiramycin. *M.V.Sc. Thesis* (Surgery and Radiology). Nanaji Deshmukh Veterinary Science University, Jabalpur, Madhya Pradesh, India.

Clarke, D.E., Kelman, M., & Perkins, N. (2011). Effectiveness of a vegetable dental chew on periodontal disease parameters in toy breed dogs. *Journal of Veterinary Dentistry*, 28(4), 230-235.

Dai, L., Nadeau, B., An, X., Cheng, D., Long, Z., & Ni, Y. (2016). Silver nanoparticles-containing dual-function hydrogels based on a guar gum-sodium borohydride system. *Scientific Reports*, 6(1), 36497.

Fakhruddin, K.S., Egusa, H., Ngo, H.C., Panduwawala, C., Pesee, S., & Samaranayake, L.P. (2020). Clinical efficacy and the antimicrobial potential of silver formulations in arresting dental caries: A systematic review. *BMC Oral Health*, 20(1), 160.

Fichtel, T., Crha, M., Langerova, E., Biberauer, G., & Vin, M.V. (2008). Observations on the effects of scaling and polishing methods on enamel. *Journal of Veterinary Dentistry*, 25(4), 231-235.

Heijl, L., & Lindhe, J. (1982). The effect of metronidazole on established gingivitis and plaque in beagle dogs. *Journal of Periodontology*, 53(3), 180-187.

Marth, E.H. (1978). *Standard Methods for the Examination of Dairy Products*. 14th Edn., American Public Health Association.

Pai, T. (2018). Clinical evaluation of effect of dental scaling and polishing on periodontal disease in dogs. *M.V.Sc. Thesis* (Surgery and Radiology). Maharashtra Animal and Fishery Sciences University, Nagpur, Maharashtra, India.

Perazzi, A., Ricci, R., Contiero, B., & Iacopetti, I. (2022). Evaluation of salivary biochemistry in dogs with and without plaque, calculus, and gingivitis: Preliminary results. *Animals*, 12(9), 1091.

Polkowska, I., Sobczynska-Rak, A., & Golynska, M. (2014). Analysis of gingival pocket microflora and biochemical blood parameters in dogs suffering from periodontal disease. *In Vivo*, 28(6), 1085-1090.

Praveen, K. (2016). Studies on dental scaling in dogs. *M.V.Sc. Thesis* (Surgery and Radiology). Indian Veterinary Research Institute, Izatnagar, UP, India.

Quest, B.W. (2013). Oral health benefits of a daily dental chew in dogs. *Journal of Veterinary Dentistry*, 30(2), 84-87.

Sandhu, H.S. (2023). *Essential of Veterinary Pharmacology and Therapeutics*, 20th edn., Kalyani Publishing Co., New Delhi, India, pp. 1098-1099.

Snedecor, G.W., & Cochran, W.G. (1994). *Statistical Methods*, 8th edn., The Iowa State University Press, Ames, Iowa, USA.

Ubertalli, J.T. (2024). Periodontitis. In: Mouth and dental disorders. *MSD Manual, Consumer Version*.

Xu, G.Y., Zhao, I.S., Lung, C.Y.K., Yin, I.X., Lo, E.C.M., & Chu, C.H. (2024). Silver compounds for caries management. *International Dental Journal*, 74(2), 179-186.

