

Osteoarthritis has a high prevalence in dogs undergoing routine dental prophylaxis

Darryl L. Millis, DVM, DACVS, DACVSMR* ; Silke Hecht, Dr Med Vet, DACVR, DECVDI 

Department of Small Animal Clinical Sciences, College of Veterinary Medicine, University of Tennessee, Knoxville, TN

*Corresponding author: Dr. Millis (dmillis@utk.edu)

Objective

The objective of this study was to determine the prevalence of radiographic osteoarthritis (OA) and the joints affected in medium to large dogs undergoing dental prophylaxis. We hypothesized that up to 50% of dogs in the study population would have radiographic OA.

Methods

This was a prospective observational study. Dogs admitted for dental prophylaxis at the University of Tennessee College of Veterinary Medicine from May 2013 to February 2014, > 11 kg, and 4 to 10 years of age without a previous diagnosis of OA were studied. Orthopedic examinations and ground reaction force measurements were performed. Radiographs of the major joints were obtained under sedation and evaluated for the presence and severity of OA.

Results

18 of 30 dogs (60%) had 1 or more joints with radiographic OA. The number of dogs with affected joints included coxofemoral (n = 11), tarsus (10), antebrachiocondylar (4), stifle (4), glenohumeral (3), and elbow (1). Dogs with OA had an average of 3 joints affected (range, 1 to 8 joints). Returned owner questionnaires indicated that 10 of 14 dogs with OA had no clinical signs, whereas 6 of 7 dogs without OA had no signs.

Conclusions

OA was common in dogs. Most owners did not realize their dog had OA. An optimal time to screen for radiographic OA is during procedures requiring sedation.

Clinical Relevance

Radiographic OA occurred in 60% of dogs, suggesting that dogs be screened for OA. Most owners did not suspect their dogs had OA, but questions regarding mobility may direct further screening.

Keywords: osteoarthritis, prevalence, lameness, ground reaction forces, radiographs

Osteoarthritis (OA) is a major disorder that can affect the welfare of dogs¹ and reportedly affects 20% of the adult canine population, but this figure is based on a survey of veterinarians and not on radiographic evidence.² One study that evaluated a canine OA checklist found that 38% of dogs had a clinical diagnosis of OA.³ However, radiographs were only made if a response to the checklist suggested OA. The actual prevalence of OA may be much higher in dogs because the prevalence is higher in some species, including cats.⁴⁻⁸ Underdiagnosis of OA may result in unnecessary pain and discomfort if owners fail to recognize subtle signs of OA and veterinarians do not evaluate for OA.

There are many causes of OA, including hip dysplasia, elbow dysplasia, articular fractures, cranial cruciate

ligament rupture, and other joint conditions.⁹ Osteoarthritis results in synovitis and articular degeneration that lead to decreased range of motion and limb use.^{2,10} Osteoarthritis can limit quality of life and contribute to life-ending decisions. A multimodal approach is used to alleviate pain and clinical signs. Although preservation of articular cartilage and joint health are goals to strive for, many owners do not realize that their dog has OA and do not bring their dogs for assessment until clinical signs and permanent cartilage damage are apparent.¹⁰

Dental disease is another common condition in dogs,¹ requiring sedation or anesthesia for dental cleaning. Dogs are also frequently anesthetized for other procedures, such as skin mass removal or sterilization surgery. If the prevalence of OA is great enough to justify the benefit of obtaining radiographs to assess joints for OA, obtaining radiographs during anesthesia or heavy sedation would be convenient.

The purpose of this research was to determine the prevalence of OA and severity of disability in dogs without a prior diagnosis of OA undergoing routine dental procedures. We hypothesized that up

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to 50% of dogs undergoing dental cleaning would have some degree of OA and as many as 50% of these would have disease severity resulting in some degree of disability or lameness as assessed by a functional score, lameness score, or ground reaction force (GRF) measurement. It was the overall goal of this research to characterize the extent of OA and identify the joints commonly affected. Data gathered from this research provide information to veterinarians regarding the frequency and severity of OA in dogs and foster earlier treatment to alleviate pain and improve the quality of life of dogs.

Methods

This study was reviewed and approved by the University of Tennessee IACUC and conducted in compliance with the USDA Animal Welfare Act and Regulations as well as the guidelines set by the American Association of Laboratory Animal Science. Owner consent was obtained for each animal. The patient population included dogs admitted for routine dental prophylaxis to the University of Tennessee Veterinary Medical Center between May 1, 2013, and February 28, 2014, weighing > 11 kg (24 lb), aged 4 to 10 years, and having a nonchondrodystrophic body type. Patients were evaluated to determine suitability for the study. Any dogs with major systemic medical problems that would affect data collection were excluded. Dogs with a previous diagnosis of OA or that had prior orthopedic surgery that might be associated with OA were excluded. A total of 30 dogs met inclusion criteria.

Owner evaluation

Owners were asked to complete a questionnaire to evaluate function and mobility at home prior to collection of data (**Supplementary Material S1**). The questionnaire was exempted from institutional review board review. The descriptive data were transformed to numerical scores, from 1 to 4 for positive behaviors (with a score of 4 being excellent and 1 being poor) and 1 to 4 for negative behaviors (with 4 being never and 1 being very frequently).

Orthopedic evaluation

All dogs were evaluated prior to sedation. A board-certified surgeon (DM) scored lameness at a walk, trot, and stance (**Supplementary Material S2**), with a score of 0 being normal and 4 being non-weight-bearing.

An orthopedic examination, a physical examination, and comfortable range of motion measurements of the tarsus, stifle, coxofemoral, carpal, elbow, and glenohumeral joints were completed by the same person (DM). Joint range of motion was performed with the patient in lateral recumbency with a standard goniometer. The maximum flexion and extension angles were recorded when the end range of motion was reached by soft tissue approximation or capsular end feel or if the patient demonstrated discomfort prior to reaching these end feels. No patient had a bony end feel.

Ground reaction forces

Ground reaction forces were measured. The primary variables obtained were peak vertical force (Z_{peak}) and vertical impulse (Z_{impulse}). An experienced handler trotted the dogs across a force plate (OR6-6 Multi-Axis; Advanced Mechanical Technology Inc) at a velocity of 1.7 to 2.0 m/s and acceleration of $\pm 0.5 \text{ m/s}^2$. A trial was considered acceptable if the ipsilateral forelimbs and pelvic limbs struck the force plate, the velocity and acceleration were within the defined limits, and there were no distracting movements of the head and neck or changes in gait as the dog crossed the force plate. Four acceptable trials of each limb were obtained for each dog. Data are reported as a percent of body weight.

Radiographs

Each dog was sedated with dexmedetomidine (2 to 3 $\mu\text{g/kg}$, IV) and butorphanol (0.1 mg/kg, IV) after their clinical evaluations and GRF measurements. Lateral and craniocaudal/dorsopalmar/dorsoplantar radiographs were obtained of the glenohumeral, elbow, carpal, coxofemoral, stifle, and tarsal joints. A board-certified veterinary radiologist (SH) evaluated each joint for OA with a scoring system similar to that used by the International Elbow Working Group¹¹ for elbow dysplasia screening:

- Score of 0 = no evidence of osteophytes
- Score of 1 = osteophytes up to 2 mm
- Score of 2 = osteophytes 2 to 5 mm
- Score of 3 = osteophytes > 5 mm

The prevalence and severity of OA and the affected joints were recorded.

Dental prophylaxis

Prior to anesthesia, blood was obtained for CBC and serum chemistry profile. Dogs were anesthetized by University of Tennessee College of Veterinary Medicine anesthesia personnel, with appropriate techniques and medications for each patient. Dental radiographs and prophylaxis were performed, along with any extractions. Dogs received deracoxib after dental procedures (1 to 2 mg/kg/d for 3 days).

Statistical analysis

Summary statistics related to demographics, frequency of OA, and joints affected were compiled. Because of the limited sample size, owner questionnaire items were compared nonparametrically between groups with the Mann-Whitney U test. After determining data were normally distributed with Shapiro-Wilk testing, GRF and range of motion data were compared among groups with the Student t test. All calculations were carried out with the software SAS (version 9.2.2; SAS Institute Inc), and significance was set at $P < .05$.

Results

A total of 32 dogs were screened, and 30 dogs met the inclusion criteria. One of the excluded dogs had received a tarsocrural arthrodesis because of trauma prior to study start; the other dog was subsequently found to have been previously diagnosed with probable OA.

Dog characteristics, prevalence, and severity of OA

Eighteen of 30 dogs (60%) had radiographic evidence of OA. Breeds of dogs with OA included mixed breed ($n = 6$), Border Collie (5), Golden Retriever (3), Labrador Retriever (2), Chesapeake Bay Retriever (1), and Boxer (1). Breeds of dogs without OA included mixed breed (8), Beagle (2), Greyhound (1), and Shiba Inu (1). The mean age of all dogs was 7.3 years, with a range of 4 to 10 years. The mean mass of dogs was 25.7 kg, with a range of 11.8 to 46.6 kg. Dogs with OA were on average 1.25 years older (7.83 years [95% CI, 6.8 to 8.8]; 6.58 years [95% CI, 5.6 to 7.6]; $P = .13$). Dogs with OA had significantly higher body mass (28.26 kg; 95% CI, 24.7 to 31.8) than dogs with no OA (21.93 kg; 95% CI, 15.92 to 27.95; $P = .028$). The frequency and severity of radiographic OA by joint is listed in **Table 1**.

Of the 18 dogs with OA, 16 had 2 or more joints affected. The number of affected joints in arthritic dogs was the following: 8 joints in 1 dog, 6 joints in

1 dog, 5 joints in 1 dog, 4 joints in 4 dogs, 3 joints in 1 dog, 2 joints in 8 dogs, and 1 joint in 2 dogs. In addition, 7 dogs had OA in 1 or more forelimb joints and 16 had OA in 1 or more pelvic limb joints. Only 2 dogs had OA of only forelimb joints; one of these had bilateral glenohumeral OA, and the other had OA in a single carpal joint. All other dogs with OA of a forelimb joint also had OA of a pelvic limb joint. Regarding the severity of osteoarthritic changes, of the 56 joints with OA, 33 were Grade 1, 21 were Grade 2, and 2 were Grade 3.

Owner questionnaire

Questionnaire responses for dogs with OA were compared to those without OA (**Tables 2 to 4**). The items that were most helpful to discriminate between dogs with and without OA included *activity*, *climbing stairs*, *descending stairs*, *lying down*, *getting up*, *difficulty moving after rest*, and *difficulty moving after major activity* ($P < .05$), although the differences in individual items and total scores were modest.

Table 1—Radiographic frequency and severity of OA by joint.

Joint	n	Without OA	With OA	OA severity		
				1	2	3
Glenohumeral						
Left	30	28	2	2	—	—
Right	30	28	2	2	—	—
Elbow						
Left	30	29	1	1	—	—
Right	30	29	1	—	1	—
Antebrachicarpal						
Left	30	26	4	4	—	—
Right	30	27	3	3	—	—
Coxofemoral						
Left	30	19	11	6	5	—
Right	30	20	10	6	4	—
Stifle						
Left	30	27	3	1	1	1
Right	30	28	2	—	1	1
Tarsus						
Left	30	22	8	4	4	—
Right	30	21	9	4	5	—

The number of dogs with and without radiographic signs of osteoarthritis (OA) is indicated. The severity of OA is scored as 1 (osteophytes up to 2 mm), 2 (osteophytes 2–5 mm), or 3 (osteophytes > 5 mm).

Table 2—Owner questionnaire scores comparing positive behaviors for dogs with and without OA in any limb.

Positive behaviors	OA	n	Score (No. of dogs)				P value
			1 (poor)	2 (fair)	3 (good)	4 (excellent)	
Appetite	N	12	—	—	2	10	1.00
	Y	18	—	—	2	16	
Mood	N	12	—	1	—	11	.622
	Y	18	—	—	4	14	
Contact/human family members	N	12	—	—	2	10	1.00
	Y	18	—	—	4	14	
Frequency of tail wagging	N	12	—	—	2	10	1.00
	Y	18	—	—	4	14	
Activity	N	12	—	—	1	11	.045*
	Y	18	—	—	9	9	
Play and games	N	12	—	—	2	10	.074
	Y	18	—	2	7	9	

P values in bold are statistically significant between dogs with and without OA.

*95% CI was 3.7–4.1 for no OA and 3.3–3.7 for OA.

Table 3—Owner questionnaire scores comparing negative behaviors for dogs with and without OA in any limb.

Negative behaviors	OA	n	Score (No. of dogs)				P value
			1 (very frequent)	2 (frequent)	3 (infrequent)	4 (never)	
Excessive panting	N	12	—	—	5	7	.103
	Y	18	—	4	8	6	
Licking of lips	N	12	1	1	3	7	.482
	Y	18	—	—	6	12	
Vocalization	N	12	1	1	2	8	.913
	Y	18	—	3	3	12	
Vocalization stretching	N	12	—	—	1	11	.632
	Y	18	—	—	3	15	
Aggressiveness/humans	N	12	—	—	2	10	1.00
	Y	18	—	—	2	16	
Aggressiveness/other dogs	N	12	—	1	6	5	.430
	Y	18	—	2	5	11	
Submissiveness/other dogs	N	9	—	1	3	5	.518
	Y	13	—	—	9	4	

Some owners did not answer all the questions, reflecting a number other than 12 or 18 for dogs with or without OA.

Table 4—Owner questionnaire scores comparing locomotion for dogs with and without OA in any limb.

Locomotion parameters	OA	n	Score (No. of dogs)				P value	95% CI
			1 (poor)	2 (fair)	3 (good)	4 (excellent)		
Walking	N	12	—	—	1	11	.193	
	Y	18	—	—	6	12		
Trotting	N	12	—	—	2	10	.249	
	Y	18	—	—	7	11		
Pacing	N	10	—	—	2	8	.405	
	Y	13	—	—	5	8		
Galloping/running	N	12	—	—	3	9	.443	
	Y	18	—	—	8	10		
Jumping	N	12	1	1	1	9	.232	
	Y	18	—	3	7	8		
Climbing stairs	N	12	1	1	—	10	.108	
	Y	18	—	4	6	8		
Descending stairs	N	12	—	—	1	11	.024	3.8–4.0
	Y	18	—	3	6	9		
Lying down	N	12	—	—	5	8	.049	3.7–4.1
	Y	18	—	—	8	10		
Getting up	N	12	—	—	1	11	.030	3.7–4.1
	Y	18	—	2	7	9		
Difficulty moving/rest	N	12	—	—	1	11	.049	3.7–4.1
	Y	18	—	—	8	10		
Difficulty moving/ major activity	N	12	—	1	—	11	.041	3.7–4.1
	Y	18	—	2	7	9		

P values in bold are statistically significant. 95% CIs are listed for those questionnaire items with significant differences between dogs with and without OA.

Some owners did not answer all the questions, reflecting a number other than 12 or 18 for dogs with or without OA.

Questionnaire items were less useful in discriminating dogs with OA of forelimb joints, with none of the items significantly different between dogs with or without forelimb OA. Dogs with pelvic limb OA had significantly lower scores than dogs with no OA for the categories *climbing stairs*, *descending stairs*, *lying down*, *getting up*, *difficulty moving after rest*, and *difficulty moving after major activity*.

Ground reaction forces

The interpretation of ground reaction data was difficult because most dogs had OA in multiple joints and these dogs may distribute weight differently compared to dogs with a single limb with OA. Also, 14 dogs had OA in both the forelimbs and pelvic limbs. Regarding the presence of OA in forelimbs or pelvic limbs,

the data were evaluated by comparing the limb with greater weight-bearing to the limb with lesser weight-bearing, rather than right versus left limb.

Forelimb GRFs— Although dogs with forelimb OA had decreased peak vertical force and vertical impulse in the limb with lesser force compared to the limb with greater force, these differences were not significant (**Table 5**). Similarly, although dogs with forelimb OA had decreased peak vertical force and vertical impulse of the forelimbs compared to dogs without OA in any limbs, the differences were not significant.

Peak braking and propulsion forces were greater in the limb with greater peak vertical force in dogs with and without forelimb OA, but these differences were not significant (**Table 6**). There were no differences between dogs with or without OA for these GRFs.

Table 5—Peak vertical force and vertical impulse of dogs with and without forelimb OA and with and without pelvic limb OA.

	Peak vertical force (%BW)		Vertical impulse (%BW)	
	Limb with greater force	Limb with lesser force	Limb with greater impulse	Limb with lesser impulse
Forelimb OA	111.2 (102.9–119.5)	105.0 (97.1–112.9)	14.6 (12.7–16.5)	14.1 (12.6–15.6)
No forelimb OA	115.4 (108.4–122.4)	110.1 (103.0–117.2)	15.1 (13.8–16.4)	13.8 (12.1–15.5)
Pelvic limb OA	71.3 (67.9–74.7)	67.6 (64.5–70.7)	9.5 (8.9–10.1)	8.87 (8.5–9.3)
No pelvic limb OA	75.1 (68.5–81.6)	73.0 (66.5–79.5)	8.3 (7.3–9.3)	8.3 (7.1–9.5)

Values are presented as mean (95% CI).

%BW = Percent of body weight.

Table 6—Peak braking and propulsion forces of dogs with and without forelimb OA and with and without pelvic limb OA.

	Peak braking force (%BW)		Peak propulsion force (%BW)	
	Limb with greater vertical force	Limb with lesser vertical force	Limb with greater vertical force	Limb with lesser vertical force
Forelimb OA	-15.7 (-14.1 to -17.3)	-11.8 (-8.5 to -15.1)	7.4 (6.4 to 8.4)	7.4 (5.8 to 9.0)
No forelimb OA	-16.7 (-14.6 to -18.9)	-13.8 (-11.4 to -16.2)	8.5 (7.4 to 9.5)	7.4 (6.3 to 8.4)
Pelvic limb OA	-6.95 (-8.0 to -5.9)	-5.76 (-6.6 to -5.0)	6.72 (5.8 to 7.7)	6.97 (6.1 to 7.9)
No pelvic limb OA	-4.9 (-5.6 to -4.2)	-5.0 (-5.7 to -4.3)	8.7 (7.2 to 10.2)	8.5 (6.8 to 10.2)

Values are presented as mean (95% CI).

Pelvic Limb GRFs— Although peak vertical force of dogs with pelvic limb OA were less in both pelvic limbs as compared to dogs with no OA, these differences were not significant (Table 5). Similarly, there were no differences in vertical impulse. Peak braking force was significantly greater in the better pelvic limb of dogs with OA than in dogs with no OA (-6.95% vs -4.90%; $P = .007$) but was not different in the worse pelvic limb (-5.76% vs -4.98%; $P = .25$; Table 6). Propulsion was reduced in both pelvic limbs of dogs with OA compared to dogs with no OA (6.72% vs 8.71%; $P = .027$ in the better pelvic limb) but was not significantly different in the worse pelvic limb (6.97% vs 8.55%; $P = .099$).

Joint range of motion

There were no significant differences in flexion, extension, or range of motion between dogs with and without glenohumeral, elbow, carpal, stifle, or tarsal joint OA. Dogs with coxofemoral OA had greater flexion of the left coxofemoral joint than dogs without OA ($P = .001$; 95% CI, 39.7 to 63.1 for dogs with OA and 92.7 to 111.7 for nonarthritic dogs) and less extension of the right coxofemoral joint compared with dogs without OA ($P = .03$; 95% CI, 152.2 to 162.4 for dogs with OA and 161.1 to 167.9 for nonarthritic dogs).

Orthopedic examination

Twelve of the 30 dogs (40%) had an abnormality (eg, joint effusion, pain, decreased range of motion) noted on orthopedic physical examination. Only 3 of the dogs were noted to be overweight, and these all had OA.

Overall, lameness scores at a stance, walk, and trot were greater in dogs with OA compared to dogs with no OA. However, the overall degree of lameness

was mild, with no score > 1. At a stance, walk, and trot, 10 of 30, 17 of 30, and 16 of 30 dogs, respectively, had a gait abnormality (score of 1 or greater). At a stance, walk, and trot, 8 of 18, 13 of 18, and 12 of 18 dogs with OA, respectively, had a gait abnormality. The difference in lameness score between dogs with and without OA of any joint approached significance in the category lameness at a walk ($P = .061$), with 13 arthritic dogs having a score of 1 and 5 dogs having a score of 0, while 4 nonarthritic dogs received a score of 1 and 8 received a score of 0. Lameness was seen in 2 or more categories for most dogs with OA. Only 3 of 18 dogs with evidence of OA (17%) had no visual lameness apparent. All these dogs had bilateral OA (coxofemoral, glenohumeral, and tarsal joints). Some gait abnormalities were present in 2 of 12, 4 of 12, and 4 of 12 dogs with no OA at a stance, walk, and trot, respectively.

Discussion

To our knowledge, this is the first study to perform a comprehensive evaluation for OA in a random group of dogs that included radiographic, clinical, and objective gait analysis. The most striking finding was the high prevalence of radiographic OA in dogs without a prior diagnosis of OA. Some degree of visual lameness was noted in 83% of dogs with OA.

Osteoarthritis was more common in pelvic limb joints, with the coxofemoral and tarsal joints being most frequently affected. Hip OA secondary to hip dysplasia is common, although the true prevalence of hip dysplasia in dogs is unknown.¹² One study¹³ performed at a veterinary teaching hospital found a prevalence of almost 20%, while another study¹⁴ found a lower prevalence. The prevalence is likely affected by breed, with 71% of Bulldogs and 66% of Estrela Mountain Dogs reported to have hip dysplasia.^{15,16}

We found a relatively high prevalence (37%) of hip OA in our study that included multiple breeds of dogs. The tarsus also had a high prevalence of OA. Comparative data on this joint is lacking in the literature. Stifle joint OA was less common, likely because most dogs have stifle OA secondary to cranial cruciate ligament rupture, which generally causes more obvious lameness, resulting in owners seeking veterinary care and limiting the number of dogs in the population studied.

Only 2 of the 18 arthritic dogs had OA limited to the forelimbs. The other 5 dogs with forelimb OA also had OA in the pelvic limb joints. This was surprising because cartilage lesions of the glenohumeral joint are commonly identified after death, with reported¹⁷⁻¹⁹ incidences of 32% to 74%. Our study had fewer dogs with radiographic OA, suggesting that degenerative lesions of the glenohumeral joints may be underestimated by radiographic evaluation. Our study found a relatively low prevalence of elbow OA. This is similar to a cadaveric study that found elbow OA in only 3% of specimens.¹⁹ Estrela Mountain Dogs evaluated²⁰ over a 20-year period had a prevalence of elbow disease of 16.5%. Another study²¹ found a similar prevalence of elbow dysplasia, which is important because elbow dysplasia generally results in OA.

Multiple joint OA was common, with 16 of 18 arthritic dogs having more than 1 joint affected, similar to another study.²² Several factors may be responsible for this result. Most forms of joint dysplasia affect the limbs bilaterally. Alternatively, if chronic trauma to joints occurs because of activity, joints may be affected bilaterally either as a primary problem or the contralateral less-affected limb may undergo compensatory changes.

Most radiographic abnormalities were mild, with 59% of the dogs having Grade 1 radiographic changes. Even with mild radiographic changes, it is likely that permanent cartilage damage has already occurred. This emphasizes the point of identifying and treating patients with OA early in the disease process prior to developing end-stage OA.

Although it may be surprising that there were few significant differences in GRFs between dogs with and without radiographic OA, the dogs in this study did not have a previous diagnosis of OA, suggesting that clinical signs, including lameness, were not obvious and dogs were minimally affected. The most significant finding was decreased propulsion in the pelvic limbs of dogs that had OA. This is logical because most dogs with pelvic limb OA had hip OA, which results in decreased propulsion during gait. A study²³ of English Bulldogs also found weight-bearing forces were altered, depending on the location and severity of OA. Hip extension is also often decreased in dogs with hip OA, as we found. The greater hip flexion with hip OA may be due to muscle atrophy, which results in soft tissue approximation after more joint flexion.

Most dogs with OA had some indication of an abnormality during orthopedic examination and evaluation of stance, walk, or trot, suggesting that these clinical examinations may be useful in screening seemingly healthy dogs for OA. Lameness evaluation must be

combined with an orthopedic physical examination because dogs with bilateral OA may not have gait asymmetry and visual lameness in the early stages, as we found in some arthritic dogs.

Questionnaire responses suggested that the items most discriminating to identify OA were *climbing stairs, descending stairs, lying down, getting up, difficulty moving after rest, and difficulty moving after major activity*. The differences in individual items and total scores were modest, however, suggesting that owners of arthritic dogs did not recognize that their dogs had mobility issues. This is important because veterinarians must act as an advocate for patients with early OA rather than wait for the owners to recognize a problem. Screening for OA should be performed in any large or giant breed of dog that is middle-aged or older. An especially opportune time to screen for radiographic OA is during annual wellness examinations or any procedure requiring sedation or general anesthesia, including dental procedures.

Our results differ from those of a large retrospective evaluation of medical records that investigated the prevalence, duration, and risk factors of OA in dogs in the UK.²⁴ The estimated annual prevalence of OA was 2.5%, with calculations suggesting that OA affects 11.4% of individuals over their lifespan. However, this estimate is based on all dogs, including smaller dogs. Because a diagnosis of OA was counted only if it was recorded in the electronic medical record, the prevalence of OA may be underreported unless patients are specifically evaluated. For example, Labrador Retrievers, Greyhounds, and Rottweilers were reported to have OA in 5.5%, 4.6%, and 4.7% of patients, respectively.²⁵⁻²⁷ As suggested by our study, owners often do not suspect that their dog may have OA, the degree of lameness may be subtle, and dogs may not have been thoroughly evaluated in a primary care setting, resulting in underreporting.²⁶

The prevalence of OA and clinical signs in dogs between 8 months and 4 years of age was evaluated in another study.²⁸ Clinical OA was defined as radiographic OA and joint pain in 1 or more joints. Radiographic OA in 1 or more joints occurred in 39.8% of dogs, with a lower number having clinical OA. Owners of dogs with clinical OA observed signs of impairment in approximately 30% of cases, with only 2 of 49 dogs receiving any pain medication. The most affected joints were the elbow, coxofemoral, tarsal, and stifle joints. Our study of older dogs with OA compared to this study of younger dogs suggests that, as dogs age, the prevalence of OA likely increases. This is supported by the fact that only 20% of dogs up to 18 months of age had radiographic OA compared with 57% of dogs that were 4 years of age, which was similar to our results. In further support of older dogs having a higher prevalence of OA, a retrospective study⁹ of dogs > 8 years of age and suspected to have an orthopedic problem found the prevalence of OA in the glenohumeral, elbow, hip, and stifle joints to be 39.2%, 58.4%, 35.9%, and 36.4%, respectively. However, radiographs were only made if dogs were suspected of having an orthopedic problem, whereas our prospective study specifically excluded a preexisting diagnosis of OA. Our results suggested that there may be a high prevalence of OA, even if an orthopedic problem is not suspected.

Several risk factors have been associated with a diagnosis of OA, including breed, early neutering, higher body weight, and greater age.^{24,29} Genetics is one of the most influential risk factors, having a significant relationship with specific joint diseases.^{30–33} Breed is a risk factor for OA, with Rottweilers, Golden Retrievers, Labrador Retrievers, Mastiffs, Italian Corso dogs, German Shepherd Dogs, and Bernese Mountain Dogs commonly affected.^{14,24,34}

Higher body weight is also associated with OA,²⁹ which is in agreement with our findings. Although obesity is associated with the incidence and severity of OA,^{35–38} only 3 dogs in our study were overweight and these all had OA. However, all dogs had body mass > 11 kg. Larger breeds of dogs may have more joint conditions that predispose to the development of OA. In people, obesity results in increased odds of 4.4 and 2.5 for developing knee or hip OA, respectively.³⁹

Aging is another risk factor for cranial cruciate ligament disease, OA of other joints,^{14,29} and hip OA.^{14,38,40} Dogs with OA in our study were older than those without OA.

Finally, early neutering may also increase the risk of joint disease.⁴¹ Although the dogs in this study had undergone gonadectomy, the specific age of the patient at the time of surgery was not collected.

There were several limitations to this study. The size and age of dogs may have potentially skewed data toward OA. Because of size limitations in obtaining GRFs, dogs > 11 kg were selected, and larger dogs are more prone to OA. Middle-aged to older dogs were recruited for this study. Older dogs are more likely to have a greater prevalence of OA. The questionnaire used in this study was one that was based on a combination of other validated questionnaires and designed to primarily assess function and mobility, but it has not been validated. Also, this study used a relatively small number of dogs and firm conclusions cannot be drawn without studying a larger group of dogs. However, despite these shortcomings, a high prevalence of OA existed in this population of dogs, especially when considering that dogs with preexisting OA were excluded.

In conclusion, OA prevalence in this population of dogs was high. Pelvic limb OA was most common, with most dogs having more than 1 joint affected. Clinical signs were subtle, suggesting that scrutiny in history-taking regarding mobility, careful observation of gait, and complete orthopedic examination are necessary to identify cases before severe lameness and end-stage OA occur.

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ORCID

Darryl L. Millis  <https://orcid.org/0000-0002-8015-3159>
Silke Hecht  <https://orcid.org/0000-0001-8805-836X>

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Supplementary Materials

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