

Outcome of medical and surgical treatment in dogs with cervical spondylomyelopathy: 104 cases (1988–2004)

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Objective—To compare outcomes and survival times for dogs with cervical spondylomyelopathy (CSM; wobbler syndrome) treated medically or surgically.

Design—Retrospective case series.

Animals—104 dogs.

Procedures—Medical records of dogs were included if the diagnosis of CSM had been made on the basis of results of diagnostic imaging and follow-up information (minimum, 6 months) was available. Ordinal logistic regression was used to compare outcomes and the product-limit method was used to compare survival times between dogs treated surgically and dogs treated medically.

Results—37 dogs were treated surgically, and 67 were treated medically. Owners reported that 30 (81%) dogs treated surgically were improved, 1 (3%) was unchanged, and 6 (16%) were worse and that 36 (54%) dogs treated medically were improved, 18 (27%) were unchanged, and 13 (19%) were worse. Outcome was not significantly different between groups. Information on survival time was available for 33 dogs treated surgically and 43 dogs treated medically. Forty of the 76 (53%) dogs were euthanized because of CSM. Median and mean survival times were 36 and 48 months, respectively, for dogs treated medically and 36 and 46.5 months, respectively, for dogs treated surgically. Survival times did not differ significantly between groups.

Conclusions and Clinical Relevance—In the present study, neither outcome nor survival time was significantly different between dogs with CSM treated medically and dogs treated surgically, suggesting that medical treatment is a viable and valuable option for management of dogs with CSM. (*J Am Vet Med Assoc* 2008;233:1284–1290)

No consensus exists on the best treatment for dogs with CSM (wobbler syndrome). Surgical treatment is commonly recommended, with several techniques having been described,^{1–3} on the basis of the theory that alleviating spinal cord compression in dogs with CSM will result in an improvement in or at least a stabilization of clinical signs. In contrast, medical treatment has generally been suggested to provide only transient benefits in dogs with CSM, with progression of clinical signs expected because the primary lesion is not directly addressed.^{1,4} To our knowledge, however, the only evidence supporting these statements comes from a single study⁵ published 3 decades ago that primarily involved Great Danes. In that study, most dogs treated medically were euthanized because of progression of the disease.

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ABBREVIATIONS

CSM	Cervical spondylomyelopathy
MRI	Magnetic resonance imaging

In contrast, a recent prospective study⁶ involving 12 Doberman Pinschers with CSM found that the progression of MRI abnormalities was slower in dogs treated medically than in dogs treated surgically.

Reported efficacy rates for various surgical treatments in dogs with CSM have ranged from 70% to 80%, with the exception of fenestration, for which the efficacy rate is only 33%.⁷ Despite the potential benefits associated with surgical treatment, severe complications can develop, with reported perioperative death rates ranging from 0% to 8.5%.^{8–13} Interestingly, the veterinary literature contains substantially more data on surgical treatment of CSM than on the efficacy of medical treatment or the natural course of the disease, and to our knowledge, no study has compared the effects of surgical versus medical treatment in a large population of dogs with CSM. In humans, despite the widespread belief that surgery is the best treatment for cervical spondylotic myelopathy, recent prospective studies^{14–16} comparing surgical and medical treatments have failed to demonstrate a superiority of surgery. It is important to note, however, that patients included in these studies

had predominantly neck pain and only mild or moderate signs of myelopathy.

Although it appears clear that surgery offers short-term improvement for most dogs with CSM, it remains to be determined whether surgery alters the long-term outcome or the natural progression of the disease. As an example, a study¹⁷ comparing 2 surgical techniques for Doberman Pinschers with CSM found that 18 of 28 (64%) dogs died or were euthanized between 24 and 40 months after surgery, with recurrence of CSM being the most common reason for euthanasia. Therefore, the purpose of the study reported here was to compare outcomes and survival times for dogs with CSM treated medically or surgically at the Ontario Veterinary College.

Materials and Methods

Case selection criteria—Medical and radiology records of the Ontario Veterinary College's Veterinary Teaching Hospital for January 1988 to December 2004 were searched to identify cases of CSM. Terms used in the search were CSM, wobbler syndrome, cervical vertebral instability, cervical spondylopathy, and vertebral malformation–malarticulation. For purposes of the present study, CSM was defined as spinal cord compression caused by intervertebral disk protrusion, bone-related compression, soft tissue compression, or a combination of these factors, with or without visible vertebral canal stenosis. Inclusion of a nontypical breed was dependent on the presence of a combination of disk protrusion with tipping and soft tissue compression (dorsal, lateral, or both) or osseous malformation causing dorsal compression, lateral compression, or both. Dogs were included in the study if the diagnosis had been made on the basis of results of myelography, computed tomography, or MRI; the dog had been treated medically or surgically at the Ontario Veterinary College; a complete medical record was available; the dog had been followed up for at least 6 months; and long-term follow-up information was provided by the owner. Dogs with CSM treated with disk fenestration alone were excluded from the study.

Medical records review—Information obtained from medical records of dogs included in the study consisted of breed, age at the time of diagnosis, sex, duration of clinical signs, medications administered prior to admission to the Ontario Veterinary College, neurologic signs at the time of initial examination (ie, cervical hyperesthesia or neck pain; mild, moderate, or severe ataxia; or nonambulatory tetraparesis), method of diagnosis (myelography, computed tomography, or MRI), location and characteristics of the main lesion, nature of the lesion (dynamic or static), and neurologic status at the time of the last evaluation at the Ontario Veterinary College. Dogs were classified as having mild ataxia if they had mild pelvic limb ataxia or paresis with or without thoracic limb involvement; this degree of ataxia could only be seen after careful gait evaluation, and paw placement was usually consistent throughout most of the evaluation. Dogs were classified as having moderate ataxia if they had moderate pelvic limb ataxia or paresis with thoracic limb involvement; this degree

of ataxia was characterized by consistent and obvious ataxia from the beginning of the evaluation, and dogs would often position the pelvic limbs in abduction or adduction during the gait examination. Dogs were classified as having severe ataxia if they had marked pelvic limb ataxia or paresis with thoracic limb involvement; this degree of ataxia was characterized by a severely abnormal gait with consistently abnormal foot placement during gait analysis, usually associated with marked pelvic limb weakness.

Myelograms and magnetic resonance images were reviewed, and the location of the main lesion was determined on the basis of the smallest dorsoventral or lateral spinal cord diameter on lateral or ventrodorsal myelographic views or on sagittal or transverse magnetic resonance images. Spinal cord signal changes on magnetic resonance images, if present, were used in conjunction with the smallest cord diameter to establish the location of the main lesion. Myelographic or magnetic resonance images obtained while linear traction was placed on the neck were used to establish whether lesions were static or dynamic. Lesions were defined as static if the degree of compression did not change during linear traction on the neck and as dynamic if the degree of compression substantially improved or the compression disappeared.

Dogs were classified as having been treated surgically or medically. Surgical treatment consisted of direct or indirect decompressive procedures, such as ventral slot, dorsal laminectomy, or distraction-fusion surgery. Before surgery, Doberman Pinschers were screened for von Willebrand disease, and affected dogs were treated with desmopressin prior to surgery. In some instances, Doberman Pinschers were also screened for dilated cardiomyopathy, and those with evidence of dilated cardiomyopathy were typically treated medically, rather than surgically, because of concerns that anesthesia and surgery could adversely affect cardiovascular function. For dogs treated surgically, information obtained from the medical records included type of procedure, duration of surgery, intra- and postoperative complications, duration of hospitalization, and clinical status at discharge (improved, worsened, or unchanged). Medical treatment consisted predominantly of restricted activity with or without corticosteroid administration; avoidance of neck collars and use of a body harness were strongly recommended. Information on corticosteroid use (drug, dose, and duration) was also obtained from the medical records of dogs treated medically or surgically. Dogs that improved after surgery and subsequently developed clinical signs that could be attributed to cervical spinal cord abnormalities were considered to have a recurrence.

Owners of dogs included in the study were telephoned to solicit their participation. Information obtained from the owners included the dog's current status (alive or dead); overall outcome after treatment (improved, worsened, or unchanged); and, for dogs that were dead, the date and cause of death. If the dog had improved during the follow-up period, the owner was asked to estimate the percentage of improvement and the time it took to reach maximal improvement. Owners were also asked to score overall quality of life of their dogs as 1 (poor), 2 (fair), or 3 (good).

The study was conducted during 2 time periods. Medical records of dogs treated between 1988 and 1998 were reviewed in 1999, and owners were contacted at that time. Owners of dogs treated between 1999 and 2004 were contacted in 2005, along with owners of dogs from the first part of the study that were still alive in 1999.

Statistical analysis—Ordinal logistic regression was used to compare outcome between dogs treated surgically and dogs treated medically and to determine whether age, duration of clinical signs, location of the lesion, or severity of clinical signs at the time of initial examination was associated with outcome. Survival data were analyzed by use of a life test (product-limit) procedure, with survival curves compared by means of the log-rank test. The Wilcoxon Mann-Whitney test was used to compare neurologic status between dogs treated medically and dogs treated surgically and to compare percentage improvement between groups for dogs that improved after treatment. The effect of corticosteroid administration on outcome of dogs treated medically was examined with the Cochran Armitage test for trends and a χ^2 test with overall contrasts. All analyses were performed with standard software.^a Values of $P < 0.05$ were considered significant.

Results

One hundred fifty-seven dogs (84 Doberman Pinschers and 73 dogs of other breeds) with CSM were examined at the Ontario Veterinary College during the study period. Thirty-one dogs were excluded from the study because the owners could not be reached or did not want to participate in the study, 15 were excluded because duration of follow-up was < 6 months, and 7 were excluded because patient information was incomplete. The remaining 104 dogs were included in the study.

Of the 104 dogs included in the study, 54 (52%) were Doberman Pinschers (Table 1) and 50 (48%) were of mixed breeding ($n = 4$) or represented other breeds (Great Danes, 12; Rottweilers, 6; German Shepherd Dogs, 5; Weimaraners, 4; Bernese Mountain Dogs, 3; Labrador Retrievers, 3; Yorkshire Terriers, 2; Boxer, 1; Bichon Frisé, 1; Catahoula Leopard Dog, 1; German Shorthaired Pointer, 1; Giant Schnauzer, 1; Maltese, 1;

Neapolitan Mastiff, 1; Newfoundland, 1; Pug, 1; Saint Bernard, 1; and Standard Poodle, 1).

Overall, 37 dogs were treated surgically and 67 were treated medically. Of the 67 dogs treated medically, 31 (46%) did not receive any medications prior to examination at the Ontario Veterinary College, 16 (24%) received NSAIDs (meloxicam, 11 dogs; aspirin, 3 dogs; carprofen, 1 dog; or paracetamol, 1 dog), and 20 (30%) dogs received corticosteroids (prednisone, 14 dogs, or dexamethasone, 6 dogs). Mean duration of NSAID administration was 52 days (range, 1 to 365 days). Mean duration of corticosteroid administration was 29.5 days (range, 1 to 240 days). Of the 37 dogs treated surgically, 11 (30%) did not receive any medications prior to examination at the Ontario Veterinary College, 8 (21%) received NSAIDs (aspirin, 4 dogs, or meloxicam, 4 dogs), and 18 (49%) received corticosteroids (prednisone, 7 dogs; dexamethasone, 8 dogs; or both, 3 dogs). Mean duration of NSAID administration was 136 days (range, 3 to 365 days). Mean duration of corticosteroid administration was 20.2 days (range, 1 to 150 days).

Severity of neurologic signs at the time of initial examination was not significantly ($P = 0.95$) different between dogs treated surgically and dogs treated medically (Figure 1). Overall, 39 of the 54 (72%) Doberman Pinschers and 25 of the 50 (50%) dogs of other breeds had a history or clinical signs of neck pain.

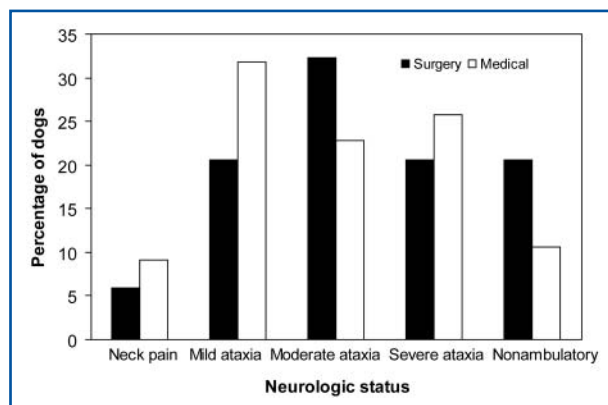


Figure 1—Distribution of neurologic status at the time of initial examination for 104 dogs with CSM treated surgically ($n = 37$) or medically (67).

Table 1—Clinical data for 104 dogs with CSM treated surgically or medically.

Variable	Doberman Pinschers ($n = 54$)		Dogs of other breeds ($n = 50$)	
	Surgical treatment (23)	Medical treatment (31)	Surgical treatment (14)	Medical treatment (36)
Age (y)*	6.6 (4.5–11)	6.6 (0.9–10.5)	7 (0.5–11)	4.7 (0.2–11.5)
Sex†				
Male	9 (39)	19 (61)	8 (57)	30 (84)
Female	14 (61)	12 (39)	6 (43)	6 (16)
Duration of signs (mo)‡	1.5 (0.03–36)	2 (0.03–84)	2 (0.03–29)	2 (0.03–84)
Surgical procedure†				
Ventral slot	18 (78)	NA	11 (79)	NA
Dorsal laminectomy	3 (13)	NA	3 (21)	NA
Distraction-fusion	2 (9)	NA	0 (0)	NA

*Data are given as mean (range). †Data are given as number of dogs (%). ‡Data are given as median (range); information was not available for 2 dogs.
NA = Not applicable.

The diagnosis of CSM was confirmed on the basis of results of myelography in 86 (83%) dogs and on the basis of results of MRI in 18 (17%) dogs. Thirteen dogs underwent both myelography and MRI.

The main lesion was located at C6-7 in 27 of the 54 (50%) Doberman Pinschers, at C5-6 in 22 (41%), and at C3-4 in 1 (2%). In the remaining 4 (7%) dogs, location of the main lesion could not be determined because 2 lesions of similar severity were observed. Overall, 39 of the Doberman Pinschers appeared to have > 1 lesion on myelographic or magnetic resonance images. The main lesion was located at C6-7 in 21 of the 50 (42%) dogs of other breeds, at C5-6 in 7 (14%), at C4-5 in 7 (14%), at C3-4 in 3 (6%), at C2-3 in 2 (4%), and at C7-T1 in 2 (4%). In the remaining 8 (16%) dogs, location of the main lesion could not be determined because \geq 2 lesions of similar severity were observed. Overall, 32 dogs of other breeds appeared to have > 1 lesion on myelographic or magnetic resonance images.

Twenty-seven of the 31 Doberman Pinschers treated medically had primarily disk-associated lesions, with 5 of the 27 having concomitant soft tissue compression. Three dogs had primarily bone-related compression, and 1 had soft tissue compression. The spinal cord compression was ventral in 22 dogs, ventral and lateral in 3, ventral and dorsal in 2, circumferential in 2, dorsal in 1, and lateral in 1. Twenty-two of the 23 Doberman Pinschers treated surgically had disk-associated lesions, with 8 of the 22 having concomitant soft tissue compressions. The remaining dog had dorsal soft tissue compression. The spinal cord compression was ventral in 14 dogs, ventral and dorsal in 5, ventral and lateral in 2, dorsal in 1, and circumferential in 1. Twenty-one of the 34 dogs of other breeds that were treated medically had disk-associated compression, with 12 of the 21 having associated soft tissue compression. The other 13 dogs had bone-related compression, with 2 of the 13 having associated soft tissue compression. The spinal cord compression was ventral in 10 dogs, ventral and dorsal in 7, ventral and lateral in 3, lateral in 8, and circumferential in 6. Eleven of the 14 dogs of other breeds that were treated surgically had disk-associated compression, with 4 of the 11 having associated soft tissue compression. The remaining 3 dogs had bone-related compression. The spinal cord compression was ventral in 8 dogs, ventral and dorsal in 4, and dorsal in 2.

Information on the nature of the lesion (dynamic or static) was available for 41 dogs (29 Doberman Pinschers and 12 dogs of other breeds). Nine of 12 Doberman Pinschers treated surgically had a dynamic lesion, 1 had a static lesion, and 2 had lesions with both static and dynamic components. Six of 17 Doberman Pinschers treated medically had a dynamic lesion, 2 had a static lesion, and 9 had lesions with both static and dynamic components. One of 3 dogs of other breeds that were treated surgically had a dynamic lesion, 1 had a static lesion, and 1 had a lesion with both static and dynamic components. Five of 9 dogs of other breeds that were treated medically had a dynamic lesion, 1 had a static lesion, and 3 had lesions with both static and dynamic components.

For Doberman Pinschers treated surgically, mean duration of surgery was 1.9 hours (range, 1.5 to 2.5

hours). Intraoperative complications were identified in 4 dogs and consisted of excessive bleeding during the ventral slot procedure. In 1 dog, surgery was discontinued because of excessive bleeding. A second surgery was attempted a few weeks later but again had to be discontinued early because of hemorrhage. As a consequence, only partial decompression was achieved. Additionally, 1 dog had 2 ventral slot procedures performed during the same surgery because the first was done at the wrong site. Mean duration of hospitalization for Doberman Pinschers treated surgically was 7 days (range, 2 to 26 days). Information on neurologic status at discharge was available for 17 of the 23 Doberman Pinschers treated surgically, with 7 of the 17 (41%) classified as improved, 5 (29%) classified as worse, and 5 (29%) classified as unchanged.

For dogs of other breeds that were treated surgically, mean duration of surgery was 1.7 hours (range, 1 to 2.5 hours). One dog had excessive bleeding during the ventral slot procedure. In a second dog, the ventral slot procedure was performed at the wrong site (a lesion was present at the site where the procedure was performed but was not considered the main lesion). Surgery was not attempted at the site of the main lesion because the owner was satisfied with the dog's improvement. Mean duration of hospitalization was 5.5 days (range, 1 to 11 days). Information on neurologic status at discharge was available for 13 dogs, with 9 of the 13 (69%) classified as improved, 1 (8%) classified as worse, and 3 (23%) classified as unchanged.

Information on corticosteroid use was available for 63 of the 67 (94%) dogs treated medically. Dexamethasone was used in 20 (32%) dogs, prednisone was used in 13 (20%) dogs, and dexamethasone followed by prednisone was used in 15 (24%) dogs. Corticosteroids were not used in the remaining 15 (24%) dogs. Mean duration of dexamethasone administration was 12 days (range, 3 to 60 days), and mean duration of prednisone administration was 107 days (range, 14 to 912 days). At the time of the last contact with the owners, 3 dogs were still receiving prednisone every other day.

Of the 15 dogs treated medically that did not receive corticosteroids, 7 (46%) improved, 4 (27%) worsened, and 4 (27%) were unchanged. Of the 48 dogs treated medically that did receive corticosteroids, 27 (56%) improved, 9 (19%) worsened, and 12 (25%) were unchanged. Outcome for dogs treated medically that received corticosteroids was not significantly (Cochran Armitage test, $P = 0.46$; χ^2 test, $P = 0.74$) different from outcome for dogs treated medically that did not receive corticosteroids.

Twenty of the 37 (54%) dogs treated surgically received anti-inflammatory medications after surgery, including 11 dogs that received dexamethasone, 7 dogs that received prednisone, 2 dogs that received dexamethasone followed by prednisone, and 1 dog that received meloxicam for 1 week. Mean duration of dexamethasone administration was 51.2 days (range, 5 to 330 days), and mean duration of prednisone administration was 50.2 days (range, 3 to 150 days).

Mean follow-up time was 30 months (range, 6 to 96 months) for dogs treated medically and 32 months (range, 6 to 156 months) for dogs treated surgically. We

did not find a significant ($P = 0.10$) difference between the percentage of dogs treated surgically that were improved (30/37 [81%]) and the percentage of dogs treated medically that were improved (36/67 [54%]; **Figure 2**). Ordinal logistic regression did not reveal any significant associations between outcome and age at the time of initial examination ($P = 0.34$), duration of clinical signs ($P = 0.13$), cervical hyperesthesia (present vs absent; $P = 0.30$), severity of ataxia (mild, moderate, or severe; $P = 0.40$), ambulatory status (ambulatory vs nonambulatory; $P = 0.38$), or location of the main lesion ($P = 0.47$).

For dogs that improved following treatment, mean owner-reported percentage of improvement was 75.5% (range, 25% to 100%) for dogs treated surgically and 70.8% (range, 50% to 100%) for dogs treated medically. Percentage of improvement did not differ significantly ($P = 0.64$) between groups. Mean time to reach maximum improvement was 2.6 months for dogs treated surgically (range, 2 days to 6 months) and 2.7 months for dogs treated medically (range, 2 days to 15 months).

Mean owner-reported scores for quality of life for Doberman Pinschers treated surgically and medically were 2.4 and 2.6, respectively. Mean owner-reported scores for quality of life for dogs of other breeds treated surgically and medically were 2.3 and 2.7, respectively.

Six of 37 (16%) dogs treated surgically (3 Doberman Pinschers and 3 dogs of other breeds) had a recurrence of clinical signs severe enough to warrant additional diagnostic testing, including myelography. Three of these dogs had initially undergone a ventral slot procedure, 2 had undergone dorsal laminectomy, and 1 had been treated with a distraction technique involving interbody implantation of a polymethyl methacrylate plug. Mean and median times between the initial surgery and follow-up diagnostic testing were 17 and 11 months, respectively (range, 6 to 33 months).

Information on survival time was obtained for 76 dogs, including 33 dogs treated surgically (20 Doberman Pinschers and 13 dogs of other breeds) and 43 dogs treated medically (19 Doberman Pinschers and 24 dogs of other breeds). Forty of the 76 (53%) dogs (16 that had been treated surgically and 24 that had been treated medically)

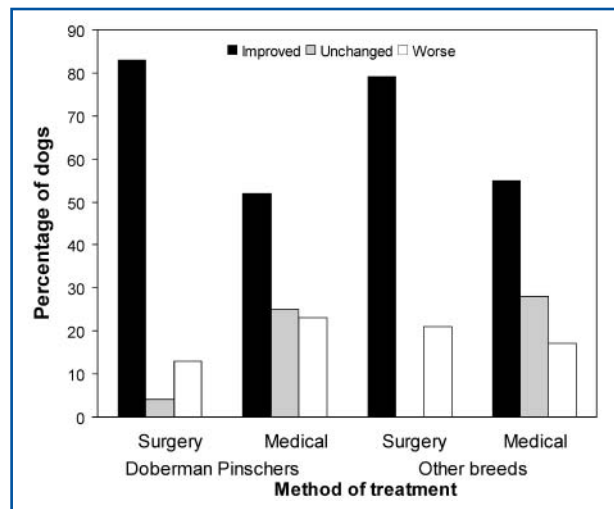


Figure 2—Distribution of owner-reported long-term (≥ 6 months) outcome for 54 Doberman Pinschers (23 treated surgically and 31 treated medically) and 50 dogs of other breeds (14 treated surgically and 36 treated medically) with CSM.

were euthanatized because of progression of clinical signs of CSM. Median and mean survival times for dogs treated surgically were 36 and 46.5 months, respectively. Median and mean survival times for dogs treated medically were 36 and 48 months, respectively. No significant ($P = 0.64$) difference was seen in survival time between dogs treated surgically and dogs treated medically.

Discussion

Results of the present study suggested that survival times for dogs with CSM that were treated surgically were not significantly different from survival times for dogs treated medically. In addition, we did not identify a significant difference in outcome between dogs treated surgically and dogs treated medically. However, the power of this analysis was low (27.4%), and given the large difference in percentage of dogs that were improved after surgical treatment (30/37 [81%]), compared with dogs that were improved after medical treatment (36/67 [54%]), we believe that a significant difference might have been found if more dogs had been included in the study. To obtain a power of 82%, 580 dogs would have been needed, a number that would be difficult to achieve even with a multicentric study.

Medical treatment of dogs with CSM has previously been suggested to result in only transient improvement, with eventual progression to an unacceptable neurologic status requiring euthanasia.^{1,4} Even though, to our knowledge, only a single study⁵ primarily involving Great Danes provides support for this statement, medical treatment of CSM has been commonly dismissed in the veterinary literature, with only a few reports^{6,18} describing a beneficial outcome associated with nonsurgical treatment in dogs with CSM. In contrast, in the present study, we found that 36 of the 67 (54%) dogs treated medically were improved and 18 (27%) were unchanged when owners were contacted to obtain long-term follow-up information, suggesting that medical treatment may be a valuable option for the management of CSM in some dogs. It must also be emphasized that we did not detect any significant differences in owner-reported percentage of improvement or owner-reported score for quality of life between dogs treated medically and dogs treated surgically, providing further support to the suggestion that medical treatment may be a viable option for treatment of dogs with CSM. On the other hand, considering that 30 of the 37 (81%) dogs treated surgically were reported to be improved and 1 (3%) was reported to be unchanged, we currently recommend surgery for treatment of most dogs with CSM.

Ideally, treatment decisions should be made on the basis of scientific evidence of the benefits and risks (eg, short- and long-term complications) associated with each potential treatment. Over the years, no objective guidelines have been established for selection of the most appropriate treatment for dogs with CSM. A number of surgical techniques have been proposed and used, even though the natural course of the disease and the benefits of medical treatment have never been established. Many of these techniques were based on the principle that lesions were dynamic or static, but the nature of the lesions in dogs with CSM has been rather poorly studied, and identification of lesions as dynamic or static is subjective.^{17,19} Also, although most dogs that

undergo surgery have a successful outcome,^{20–25} complications, including death, can occur. In a study¹¹ of 112 dogs that underwent a ventral slot procedure, for instance, 14.9% developed clinically important complications, and the mean mortality rate for studies^{8–13} involving a total of 771 dogs undergoing decompressive surgery of the cervical portion of the spine was 3% (range, 0% to 6.3%). Also, the risk of complications may be higher in Doberman Pinschers because they have high incidences of bleeding diatheses and dilated cardiomyopathy. Moreover, general anesthesia can exacerbate arrhythmias and worsen left ventricular function in dogs with occult dilated cardiomyopathy.²⁶ Thus, the benefits, risks, and likely outcomes of medical and surgical treatment should be discussed with owners to allow an educated decision to be reached.

Several mechanisms probably played a role in the improvement observed in dogs in the present study that were treated medically. It is likely that the restriction of activity eliminated or reduced the dynamic component of spinal cord compression, which is known to be a more important mechanism in the pathogenesis of spinal cord injury than static compression.^{27,28} In addition, most dogs that were treated medically received dexamethasone, prednisone, or both. Even though we did not detect an association between corticosteroid use and outcome, corticosteroids appear to have a neuroprotective function in acute spinal cord injury,²⁹ although their function in chronic spinal cord compression is somewhat different.³⁰ Corticosteroids, particularly dexamethasone, improve neurologic function in rats with chronic spinal cord compression, predominantly by decreasing vasogenic edema.³¹ Other proposed mechanisms include protection from glutamate toxicosis and reduction of neuronal and oligodendroglial apoptosis.^{32–34} Despite the potential benefits associated with corticosteroid administration, it is important to emphasize that use of corticosteroids, particularly for longer periods, can be associated with important adverse effects. Gastrointestinal tract ulceration, colonic perforation, iatrogenic hypoadrenocorticism, pulmonary thromboembolism, infection, overt diabetes mellitus, and behavioral changes have all been associated with corticosteroid treatment.³⁵ Finally, it is likely that surviving demyelinated axons may have remyelinated with treatment. Remyelination has been shown in the spinal cords of horses and humans with cervical myelopathy treated medically.^{36,37}

Importantly, 26 of the 37 (70%) dogs treated surgically in the present study had been treated with anti-inflammatory drugs before being treated at the Ontario Veterinary College. This would suggest that some dogs underwent surgery because previous medical treatment had failed. On the other hand, 36 of the 67 (54%) dogs treated medically had also been treated with anti-inflammatory drugs before being treated at the Ontario Veterinary College and were referred because the improvement was less than ideal. Notably, the outcome for dogs in the present study that were treated medically and received corticosteroids was not significantly different from the outcome for dogs treated medically that did not receive corticosteroids. Thus, medical treatment consisted primarily of a temporary or permanent

change in lifestyle (eg, exercise restriction and use of a body harness instead of a neck collar).

To our knowledge, the natural course of CSM in dogs has never been studied, as determining the natural course of this disease would require that no therapeutic interventions be used, which would be difficult and ethically questionable. Results for dogs in the present study that were treated medically would likely reflect the natural course of CSM and suggest that CSM in dogs progresses slowly. In addition, our findings suggest that the long-term course in dogs with CSM is not affected by surgery because survival times were similar for dogs treated medically and surgically. A slow progression of vertebral and spinal cord changes in dogs with CSM was also found in a recent study⁶ involving 12 Doberman Pinschers with CSM that underwent follow-up MRI.

The present study shares some of the limitations common to previous retrospective studies describing treatment for dogs with CSM. In particular, outcome assessments were based primarily on owners' perception of improvement and recollection. The neurologic assessment of severity of ataxia was also subjective, and the follow-up survey was not validated. However, because follow-up information was collected in the same manner for all dogs in the present study, this limitation affected both groups equally. The large patient population studied should have also minimized potential owner bias in terms of surgical or medical treatment. However, a potential source of bias was the possibility that owners of dogs treated surgically overestimated the degree of improvement in their dogs because of the substantial investment of time and resources associated with surgery. Prospective studies comparing various methods of treatment in dogs with CSM should be performed.

We believe that even though we did not identify a significant difference between groups in the present study, surgery offers a higher chance of clinical improvement, compared with medical treatment, but does not offer a longer survival time. Medical treatment improved or stabilized the clinical status of 81% (54/67) of dogs. Percentage improvement and quality of life were also similar for dogs treated surgically and medically. These findings suggest that both medical and surgical treatment can be successful in dogs with CSM and that the choice of treatment should take into consideration the benefits and risks of each modality, as well as the short- and long-term expectations of the owners.

a. SAS, version 8.2, SAS Institute Inc, Cary, NC.

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