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USA Office: **Intrauma America LLC** - Suite 304 - 50 Harrison str.
07030 Hoboken - NJ - P. 201.420.0110 - F. 201.420.0228
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Evaluation of the Success of Medical Management for Presumptive Thoracolumbar Intervertebral Disk Herniation in Dogs

JONATHAN M. LEVINE, DVM, Diplomate ACVIM (Neurology), GWENDOLYN J. LEVINE, DVM, SCOTT I. JOHNSON, DVM, Diplomate ACVECC, SHARON C. KERWIN, DVM, MS, Diplomate ACVS, BIANCA F. HETTLICH, T. Diplomate ACVS, and GEOFFREY T. FOSGATE, DVM, PhD, Diplomate ACVPM

Objective—To determine the success of medical management of presumptive thoracolumbar disk herniation in dogs and the variables associated with treatment outcome.
Study Design—Retrospective case series.
Animals—Dogs (n = 223) with presumptive thoracolumbar disk herniation.
Methods—Medical records from 2 clinics were used to identify affected dogs, and owners were mailed a questionnaire about success of therapy, recurrence of clinical signs, and quality of life (QOL) as interpreted by the owner. Signalment, duration and degree of neurologic dysfunction, and medication administration were determined from medical records.
Results—Eighty-three percent of dogs (185/223) were ambulatory at initial evaluation. Successful treatment was reported for 54.7% of dogs, with 30.9% having recurrence of clinical signs and 14.4% classified as therapeutic failures. From bivariable logistic regression, glucocorticoid administration was negatively associated with success ($P = .008$; odds ratio [OR] = .48) and QOL scores ($P = .004$; OR = .48). The duration of cage rest was not significantly associated with success or QOL. Nonambulatory dogs were more likely to have lower QOL scores ($P = .01$; OR = 2.34).
Conclusions—Medical management can lead to an acceptable outcome in many dogs with presumptive thoracolumbar disk herniation. Cage rest duration does not seem to affect outcome and glucocorticoids may negatively impact success and QOL. The conclusions in this report should be interpreted cautiously because of the retrospective data collection and the use of client self-administered questionnaire follow-up.
Clinical Relevance—These results provide an insight into the success of medical management for presumptive thoracolumbar disk herniation in dogs and may allow for refinement of treatment protocols.

INTRODUCTION

INTERVERTEBRAL DISK herniation is a general term that refers to disk extrusion, protrusion or bulge.[1–3] Disk extrusion is defined as rupture of the annulus fibrosus with displacement of the nucleus pulposus into the vertebral canal.[4] Disk protrusion describes partial rupture of the annulus fibrosus with translocation of the nucleus into the disrupted annulus.[4] The term disk bulge indicates annular hypertrophy without nuclear displacement.[3] Herniated disk material can lead to spinal cord compression and contusion, nerve root entrapment, meningeal irritation, and secondary spinal cord injury.[5,6] Signs associated with disk herniation depend on the severity and location of injury and can include paraspinal hyperesthesia, ataxia, paresis, Schiff–Sherrington posture, urinary incontinence, fecal incontinence, and in some cases spinal shock.[4,7–9] The most frequently affected vertebral

From the Departments of Small Animal Clinical Sciences and Veterinary Integrative Biosciences, College of Veterinary Medicine and Biomedical Sciences, Texas A&M University, College Station, TX; and Emergency Animal Hospital of NW Austin, Austin, TX.
Address reprint requests to Dr. Jonathan M. Levine, DVM, Diplomate ACVIM (Neurology), Small Animal Clinical Sciences, College of Veterinary Medicine and Biomedical Sciences, Texas A&M University, College Station, TX 77843-4474.
E-mail: jlevine@cvm.tamu.edu.
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column region in the dog is the thoracolumbar area, which accounts for 66–83.6% of the reported cases.[10,11]

Medical or surgical treatment options can be used in dogs with thoracolumbar disk herniation. Medical treatment can consist of combinations of cage rest, physical rehabilitation, and administration of analgesics, muscle relaxants, and anti-inflammatory drugs (glucocorticoids or nonsteroidal anti-inflammatory drugs [NSAIDs]).[12–14] The relative value of these medical interventions is unknown, although most authors emphasize the importance of rest and analgesics.[12,14,15] Medical therapy is usually reserved for ambulatory dogs with an acute history of clinical signs, although under certain circumstances it has been used in nonambulatory or chronically affected dogs.[12–14] Surgical treatment is traditionally used when there is nonambulatory paraparesis or paraplegia, chronic neurologic signs, or lack of improvement or decline with medical management.[12–14]

Limited data are available concerning the success of medical therapy for dogs with suspected thoracolumbar disk herniation. Much of the data were generated between 1960 and 1990 and often suffer from lack of statistical analysis, inconsistent patient follow-up, case selection bias, weak inclusion criteria, and use of therapies that are today viewed as nonstandard (e.g., parenteral vitamin E/selenium administration). Reported success rates for ambulatory dogs with presumed thoracolumbar disk herniation range from 82% to 88% and those for nonambulatory dogs with suspected thoracolumbar disk herniation range from 43% to 51%.[16–19] Clinical recurrence in dogs with medically managed presumed thoracolumbar disk herniation is estimated to range from 34% to 40%.[16,20] Hoerlein reported lack of improvement or recurrence in 49% of medically managed dogs with paresis or paralysis because of presumptive thoracolumbar disk herniation.[21]

Our purpose was to systematically review outcome in dogs with medically managed suspected thoracolumbar disk herniation. Variables such as degree of neurologic dysfunction, duration of clinical signs, signalment, weight, duration of cage rest, and medication administration were investigated with reference to owner assessment of quality of life (QOL), initial treatment failure, and recurrence of clinical signs. We hypothesized that medical management would be successful in many dogs with mild neurologic signs (i.e. paraspinal hyperesthesia with or without mild ambulatory paraparesis), but would have limited efficacy in nonambulatory dogs.

MATERIALS AND METHODS

Inclusion Criteria

Electronic medical records (January 1999–August 2005) from Texas A&M University (TAMU) or at one of 3 locations of Emergency Animal Hospital of NW Austin were searched for dogs with a diagnosis of "intervertebral disk herniation," "thoracolumbar intervertebral disk herniation," "thoracic intervertebral disk herniation," "lumbar intervertebral disk herniation," and "cervical intervertebral disk herniation." For inclusion, the record needed to document that medical management was chosen by the client and veterinarian. Each record was subsequently reviewed by 1 of 2 authors (JML, SIJ) to ensure that it met the following inclusion criteria concerning client history, physical examination, and neurologic evaluation that would allow classification as presumptive disk herniation. Client history needed to suggest that neurologic dysfunction was limited to the spinal cord or vertebral column. Physical examination had to be within normal limits, with the exception of disturbances that might be directly related to the neurologic dysfunction (e.g., dehydration, pressure sores) or were felt to be incidental (e.g., skin disease, low-grade heart murmur). The results of neurologic examination had to show clinical signs limited to the spinal cord or vertebral column. Vertebral column radiography and myelography, when performed, were used to exclude other causes including diskospondylitis, fracture, meningomyelitis, and neoplasia.

Data Collection

A written questionnaire (see Appendix A), approved by the TAMU Institutional Review Board, was sent to clients of dogs identified from 2 clinics (TAMU, emergency hospitals) during August 2005 and March–April 2006, respectively. Grouping into presumed cervical or thoracolumbar disk herniation was not carried out before mailing the questionnaire. The questionnaire instrument was not previously evaluated for repeatability or validity, and had 12 questions, which had various formats including yes/no, multiple-choice, closed-ended, and open-ended questions. Recipients were asked about the duration of cage rest, the initial success of medical therapy, the number and extent of recurrences of pain or ataxia/paresis as medical therapy was completed, signs potentially associated with incomplete response to medical therapy (e.g., chronic pain, lethargy, urinary incontinence, or fecal incontinence), overall QOL as a numerical score (range 0–10, with 10 being the best possible), and subsequent necessity for surgery or euthanasia. Clients from TAMU who had known addresses, but did not respond were contacted by phone to solicit an oral or written reply to the questionnaire. Clients from the emergency clinics who had known addresses, but did not respond were sent a reminder post card 2–3 weeks after the questionnaire was sent, followed by another copy of the questionnaire 2–3 weeks after the postcard was mailed. These method differences occurred because we were unable to access client phone numbers from the emergency clinics.

Returned questionnaires were grouped into either presumed cervical or presumed thoracolumbar disk disease based on veterinarian diagnosis; only the results of the dogs with presumed thoracolumbar disk herniation are reported here. Dogs with possible involvement of both the cervical and thoracolumbar vertebral column were retained in both groups. All

dogs had signalment, weight, duration of neurologic dysfunction, time between initial visit and return of the questionnaire (follow-up time), a previous history of vertebral column surgery, and prescribed medications at the time of initial evaluation recorded from the medical record.

Neurologic Assessment

A modified numerical Frankel spinal cord injury score (neuroscore)[22–24] was established, by reviewing neurologic examination data from the record. Dogs were classified as having paraplegia or tetraplegia with no deep nociception (grade 0), paraplegia or tetraplegia with no superficial nociception (grade 1), paraplegia or tetraplegia with nociception (grade 2), nonambulatory paraparesis or tetraparesis (grade 3), ambulatory paraparesis or tetraparesis and ataxia (grade 4), or spinal hyperesthesia only (grade 5). In dogs where modified Frankel score could only be estimated as a range of values (e.g., 1–2 or 2–4), an approximated grade defined as the middle of the range was used. If a modified Frankel score could not be established based on the medical record, the dog was excluded from portions of the analysis that required that value.

Outcome

Dogs were classified into 3 outcome groups based on response to medical management: (1) successful outcome, (2) initial success with recurrence, and (3) initial failure of therapy. Dogs classified as having a successful outcome were reported by the owner to be completely normal or substantially improved after therapy and lacked evidence of recurrence of clinical signs. Dogs in the initial success with recurrence group were reported to have been either completely normal or substantially improved after treatment, but had episodes of paraspinal hyperesthesia, ataxia, or weakness after recovery. Initial failure was defined as decline or lack of improvement after completion of medical management or necessity for surgery or euthanasia within 1 month of the completion of medical management.

Recurrence

Dogs were classified as having mild, moderate, or severe recurrence based on the number, length, and severity of episodes. Dogs that became nonambulatory, were euthanatized, or required surgery because of recurrence were included in the severe recurrence group. Dogs with recurrence that could not be classified as severe had the number of days/year recorded during which episodes of neurological worsening occurred. A median days of recurrence/year value was determined for this group and dogs above the median were assigned as moderate recurrence whereas dogs below the median were grouped as mild recurrence.

Statistical Methods

Descriptive analyses were performed estimating the proportion of successful outcomes in relationship with measured variables. For these descriptive purposes, the proportion of dogs that had either successful outcome or no severe recurrence with an owner-approximated QOL score of 10 was also determined. These proportions were compared across categories of measured factors using χ^2 tests. QOL scores were also compared across categories using Mann–Whitney U tests when the number of groups was 2 and Kruskal–Wallis tests for ≥ 3 groups. Continuous variables were compared between successful outcomes and nonsuccessful outcome groups using Mann–Whitney U tests.

Success, defined as initial treatment success without owner reported recurrence of clinical signs, was used for statistical modeling procedures. Bivariable logistic regression was used to investigate the association between measured variables and success. Multivariable logistic regression was used to estimate associations found to be significant in the bivariable analysis. Variables included in multivariable models as potential confounders were hospital location (TAMU, emergency clinics), duration of clinical signs at admission, duration of cage rest, time lag between initial admission and questionnaire receipt (follow-up time), modified Frankel spinal cord injury score, age, and weight. Continuous variables were included in multivariable models without transformation or categorization. Bivariable ordinal logistic regression was used to investigate the effect of study variables on owner-reported QOL scores. QOL was categorized into quartiles as 0–6, 6.5–8, 8.5–9.5, and 10 for these analyses.

A random sample of 10% of the nonresponders within each institution was selected and data concerning signalment, duration of clinical signs at presentation, and neuroscore were recorded. Categorical variables were compared between responders and nonresponders using χ^2 tests. Continuous variables were compared between these 2 groups using Student t tests. All statistical analyses were performed using software (SPSS version 11.5, SPSS Inc., Chicago, IL), and results were interpreted at the 5% level of significance.

RESULTS

Questionnaire Responses

TAMU. Of 1004 records, 182 met the inclusion criteria and questionnaires were mailed and 86 were returned because of an incorrect address; 65 correctly completed questionnaires were returned. Eight questionnaires were incorrectly completed or indicated that surgical management was the only therapy attempted; these were excluded. Twenty-three clients were reached by telephone after they did not respond to the questionnaire mailing; 21 agreed to participate. The overall response rate was 51.6% (94/182), with 47.3% (86/182) included in the analysis.

Emergency Clinics. Of 1283 records identified, 1069 met the inclusion criteria and questionnaires were mailed; 293 were returned because of an incorrect address. Subsequent mailings included smaller subsets of clients, with respondents and clients with unknown addresses excluded. A total of 217 correctly completed questionnaires were returned; 99 questionnaires were incorrectly completed or indicated that surgical management was the only therapy attempted; these were excluded. Four hundred and sixty questionnaires were not returned. The overall response rate was 29.6% (316/1069), with 20.3% (217/1069) included in the analysis.

Thus, a total of 303 dogs with correctly completed questionnaires were identified from both clinics (TAMU—86; emergency clinics—217). From completed questionnaires, 223 dogs were classified as having presumptive thoracolumbar disk herniation; 8 dogs also had signs suggestive of cervical vertebral column involvement.

Signalment

Represented breeds were: Dachshund (87; Miniature, and Standard Dachshunds were grouped together), Mixed-breed (23), Poodle (12; Toy, Miniature, and Standard were grouped together), Beagle (11), Lhasa Apso (10), Cocker Spaniel (9), Miniature Schnauzer (8), Chihuahua (6), Pekingese (4), Shih Tzu (4), German Shepherd Dog (3), Jack Russell Terrier (3), Bassett (2), Bichon Frise (2), Gordon Setter (2), Maltese (2), Papillon (2), Pomeranian (2), Pug (2), Rat Terrier (2), Shetland Sheepdog (2), Siberian Husky (2), and 1 each of 23 other breeds.

Forty dogs had vertebral column radiography that was described as either normal or suggesting disk herniation (disk space collapse, mineral opacity in the vertebral canal, small intervertebral foramen, or increased articular process overlap). Two dogs with radiography also had myelography that identified lesions consistent with disk herniation.

Descriptive statistics relating success proportion and QOL to sex, weight, age, duration of clinical signs, modified Frankel score at admission, NSAID and glucocorticoid administration, and duration of cage rest are reported in Tables 1 and 2.

Outcome

One hundred twenty-two dogs (54.7%) were managed successfully with medical therapy, 69 (30.9%) had clinical recurrence (26 mild, 23 moderate, 20 severe), and 32 (14.4%) had therapeutic failure. The mean time between initial admission and receipt of the questionnaire (follow-up time) was 3.06 years (range, 0.42–7.08) for dogs with a successful outcome and 3.57 years (range, 0.42–7.08) for dogs considered to have an unsuccessful outcome. Based on responses to question 9, chronic pain was reported in 41 dogs, weight gain in 26 and weight loss in 23 dogs, urinary incontinence in 20, and fecal incontinence in 14. Four dogs had a history of previous vertebral column surgery. Bivariable logistic regression (Table 3) suggested that glucocorticoid administration was negatively associated with success, odds ratio (OR) = 0.48. This association was not confounded by duration of clinical signs, duration of cage rest, duration of follow-up, hospital type, neuroscore at admission, age, or weight based on multivariable logistical regression modeling.

The duration of clinical signs at admission was a significant predictor of success in both the bivariable and multivariable model. Duration of cage rest enforced by the client did not influence the probability of a successful outcome. Bivariable ordinal logistic regression showed that glucocorticoid administration was also associated with low owner-reported QOL ($P = .004$; OR = 0.48; Table 4). The type of glucocorticoid, duration of glucocorticoid administration, and dosage of glucocorticoid selected did not affect associations with QOL. Increasing modified Frankel scores ($P = .003$; OR = 1.42), ambulatory neurologic status ($P = .01$; OR = 2.34), and NSAID administration ($P = .009$; OR = 2.03) were associated with higher QOL values. Increasing age ($P = .001$; OR = 0.88) and duration of clinical signs ($P = .048$; OR = .99) were associated with lower QOL scores. The duration of cage rest did not affect respondent-reported QOL scores.

Seventy nonresponders were randomly selected proportional to the total number/clinic and mean (minimum, median, maximum) age, duration of signs at admission, and neuroscore were 5.6 years (0.5, 4.5, 14.0), 22.5 days (1, 1, 1277), and 4.2 (0, 5, 5), respectively. Dogs of owners who were nonresponders were not significantly different from those who responded based on sex, breed (chondrodystrophoid versus nonchondrodystrophoid), age, duration of clinical signs, and neuroscore at admission.

DISCUSSION

Our results agree with older data[16,17,19,20] that indicate that medical management often leads to favorable outcomes in dogs with presumptive thoracolumbar disk herniation. Successful outcomes (significant improvement in neurologic function with no report of recurrence of clinical signs) were achieved in 54.4% of the dogs and treatment failure (euthanasia or necessity for surgical intervention) only occurred in 14.4% of the dogs. Whereas clinical recurrence appeared to be high (30.9% of

Table 1. Descriptive Statistics and Comparison of Potential Confounders Between 122 Dogs with Successful and 101 Dogs with Unsuccessful Treatment of Intervertebral Disk Herniation Using Medical Management from 2 Clinics (1999–2005)

Variable	Number of Dogs	Number Successful (Proportion)	*P* Value*	Number Successful or 10 QOL (Proportion)†	*P* Value*	QOL Mean (Minimum, Median, Maximum)	*P* Value‡
Clinic			.448		.814		.159
TAMU	65	33 (0.51)		41 (0.63)		8.31 (0, 9.5, 10)	
Emergency clinics	158	89 (0.56)		97 (0.61)		7.89 (0, 9.5, 10)	
Sex			.537		.239		.648
Female intact	16	11 (0.69)		13 (0.81)		8.64 (0, 9.75, 10)	
Female spayed	86	49 (0.57)		56 (0.65)		8.09 (0, 9, 10)	
Male intact	31	15 (0.48)		17 (0.55)		7.72 (0, 9, 10)	
Male neutered	90	47 (0.52)		52 (0.58)		7.95 (0, 9, 10)	
Duration of clinical signs			.263		.322		.236
$\leq$ 1 day	130	75 (0.58)		83 (0.64)		8.24 (0, 9, 10)	
>1–7 days	67	36 (0.54)		42 (0.63)		7.97 (0, 9, 10)	
>7 days	25	10 (0.40)		12 (0.48)		6.90 (0, 8, 10)	
Neuroscore at admission§			.271		.075		.010
0	3	0 (0.0)		0 (0.0)		0 (0, 0, 0)	
1	7	4 (0.57)		4 (0.57)		5.29 (0, 8, 10)	
2	5	2 (0.40)		2 (0.40)		5.70 (0, 7, 9)	
3	23	13 (0.57)		13 (0.57)		7.65 (0, 9, 10)	
4	63	30 (0.48)		35 (0.56)		8.29 (0, 9, 10)	
5	122	73 (0.60)		84 (0.69)		8.35 (0, 9, 10)	
Ambulatory at admission			.522		.098		.010
Yes	185	103 (0.56)		119 (0.64)		8.33 (0, 9, 10)	
No	38	19 (0.50)		19 (0.50)		6.53 (0, 8, 10)	
Duration of cage rest			.825		.923		.835
None	55	31 (0.56)		34 (0.62)		7.60 (0, 9, 10)	
$\leq$ 1 week	48	28 (0.58)		30 (0.63)		7.51 (0, 9, 10)	
>1–3.5 weeks	50	28 (0.56)		33 (0.66)		8.46 (0, 9, 10)	
$\geq$ 4 weeks	62	31 (0.50)		37 (0.60)		8.32 (0, 9, 10)	
NSAID administered¶			.948		.887		.006
Deracoxib	25	17 (0.68)		18 (0.72)		9.11 (5, 10, 10)	
Carprofen	42	22 (0.52)		24 (0.57)		8.68 (0, 10, 10)	
Other	13	5 (0.38)		8 (0.62)		7.64 (1, 10, 10)	
Any	80	44 (0.55)		50 (0.63)		8.65 (0, 10, 10)	
None	143	78 (0.55)		88 (0.62)		7.68 (0, 9, 10)	
Glucocorticoids administered			.011		.028		.003
Yes	105	48 (0.46)		57 (0.54)		7.64 (0, 8.75, 10)	
No	118	74 (0.63)		81 (0.69)		8.37 (0, 10, 10)	
Glucocorticoid administered			.146		.235		.008
Prednisone	51	19 (0.37)		25 (0.49)		8.11 (0, 9, 10)	
Dexamethasone	46	26 (0.57)		29 (0.63)		7.56 (0, 8.75, 10)	
Methylprednisolone sodium succinate	8	3 (0.38)		3 (0.38)		5.13 (0, 6.5, 8)	

*P value based on χ^2 test.

†Includes mild and moderate recurrences in which the owner reported a quality-of-life score (QOL) of 10.

‡P value based on the Mann–Whitney U test for comparison of two categories and the Kruskal–Wallis test for three or more categories.

§The first 3 categories (0–2) were combined before performing statistical testing because of the small number of observations.

¶Statistical testing based on the comparison between any nonsteroidal anti-inflammatory drug (NSAID) and none.

Table 2. Descriptive Statistics and Comparison of Potential Confounders Between 122 Dogs with Successful and 101 Dogs with Unsuccessful Treatment of Intervertebral Disk Herniation Using Medical Management from 2 Clinics (1999–2005)

	Success		Not Success	
Variable	Mean (Median)	Minimum, Maximum	Mean (Median)	Minimum, Maximum
Duration of follow-up (years)	2.99 (2.41*)	0.42, 7.08	3.55 (3.58*)	0.42, 7.08
Weight (lbs)	24.9 (18.5)	3.8, 98.0	22.9 (17.8)	6.0, 83.7
Age (years)	6.30 (6.00)	0.5, 15.0	6.06 (6.00)	1.0, 15.0
Duration of clinical signs (days)	5.1 (1.0)	1, 180	18.4 (1.0)	1, 180
Neurology score at presentation	4.4 (5.0)	1, 5	4.2 (4.0)	0, 5
Duration of cage rest (weeks)	2.2 (1.5)	0, 16	2.3 (2.0)	0, 8

*Medians between success and not success significantly different at $P < .05$ using a Mann–Whitney U test

dogs), recurrence included dogs with even a single episode of paraspinal hyperesthesia reported by the owner. If dogs with only mild recurrence, which usually consisted of isolated episodes of paraspinal hyperesthesia or ataxia, were discounted from this group exacerbation of clinical signs would have occurred in only 19.3% of the dogs. This is similar to 2 recent studies of dogs with surgically treated thoracolumbar disk herniation (15.8–19.2%), where dogs with paraspinal hyperesthesia only were not considered as having recurrence.[25,26] The more conservative definition of success was used in our study to reduce subjectivity in outcome determination for the statistical modeling.

Whereas the degree of neurologic dysfunction at initial evaluation was not associated with success, more severely affected dogs did have significantly lower QOL scores. The retrospective nature of modified Frankel score assignment may have limited our ability to detect a relationship between dysfunction and success. Another potential limitation was the small number of severely affected dogs (only 3 had modified Frankel grades = 0) that were included. The statistical test comparing the success proportion in the grade 0 group with grades 1–5 only had 3% power to detect a success proportion of ≤ 0.33 in the more severely affected group. The lack of association between neurologic score and success may also indicate that some severely affected dogs that are not candidates for surgical intervention may respond well to medical management. Work by Davies and Sharp[16] indicated that 10 of 10 dogs that were paraplegic because of presumptive disk herniation but were urinary continent had successful outcomes with medical management; paraplegic dogs in this same study that had urinary incontinence and/or loss of nociception and were managed medically had poor outcomes (3/20 judged as successful). Whereas it is our opinion that nonambulatory dogs with disk herniation are best managed by surgical intervention, as improvement to ambulatory status ranges from 86% to 96%[27–30] in dogs with intact nociception, medical therapy may still be effective in some cases.

In veterinary medicine, cage rest is typically viewed as essential for successful medical management of presumptive disk herniation as it may allow for healing of ligamentous structures, prevent further extrusion of the nucleus pulposus, and may reduce the probability of accidental traumatic injury in ataxic dogs.[12–15] Cage rest is usually defined as confinement to a small run or cage at all times except when the animal needs to eliminate. The recommended duration of cage rest is variable, with some authors suggesting upwards of 6 weeks.[13] In human medicine, where an evidence-based approach has been used, long-term bed rest is generally not viewed as beneficial in the treatment of lumbar disk herniation.[31–34] Whereas bed rest can relieve radiating pain, reduce intradiscal pressure, and improve intraneural blood flow, it may also have negative effects on the vertebral column.[33,35–37] Applying data from human studies to quadruped animals may not be relevant because the forces on the vertebral column, type of disk degeneration, and ability to restrict activity likely differ between these groups. Animal experimental models do suggest that exercise is important to disk nutrition and that prolonged unloading of the intervertebral disks may lead to reduced metabolism and disk degeneration.[38–40] To our

Table 3. Bivariable Logistic Regression for the Prediction of a Successful Outcome as Defined by Initial Success of Medical Therapy Without Recurrence During the Follow-Up Period from 2 Clinics (1999–2005)

Variable	Parameter Estimate ($\hat{\beta}$)	P-Value (Wald)	Odds Ratio (95% CI)
Duration of signs (days)	−0.011	.032	.99 (.98, 1.00)
Duration of cage rest (weeks)	−0.029	.610	.97 (.87, 1.09)
Glucocorticoid use	−0.726	.008	0.48 (0.28, 0.83)

Table 4. Bivariable Ordinal Logistic Regression for the Prediction of Quality of Life (QOL) During Follow-Up from 2 Clinics (1999–2005)

Variable	Parameter Estimate ($\hat{\beta}$)	*P* value (Wald)	Odds Ratio (95% CI)
Age (years)	−0.126	.001	.88 (.82, .95)
Duration of clinical signs (days)	−0.007	.048	.99 (.99, 1.00)
Neuroscore at admission	0.353	.003	1.42 (1.13, 1.80)
Dog ambulatory at admission	0.850	.010	2.34 (1.23, 4.46)
Duration of cage rest (weeks)	0.054	.304	1.06 (.95, 1.17)
NSAID administration	0.709	.009	2.03 (1.19, 3.46)
Glucocorticoid administration	−0.730	.004	.48 (.29, .79)

QOL categorized as 0–6, 6.5–8, 8.5–9.5, and 10 for modeling.
NSAID, nonsteroidal anti-inflammatory drug.

knowledge, the efficacy of cage rest for presumed or confirmed disk herniation in the dog has not been investigated previously. It is interesting that in our population of 223 dogs, the duration of cage rest as reported by respondents did not influence the success of medical management. Cage rest duration also did not alter owner-reported QOL scores. One concern in any study is whether the sample size is sufficient to resolve group differences; however, the power of the statistical test to compare no cage rest with all other levels had 82% power to detect a 1.6 times better success proportion in those reporting any cage rest. These results support the fact that the number of dogs in this study was not a factor in making appropriate conclusions. Whereas the lack of association between outcome and cage rest duration might be related to limitations in our study design, it is also possible that protracted strict exercise restriction is not warranted in dogs with medically managed disk herniation. Early controlled mobilization and physical rehabilitation have been shown to hasten the recovery or improve the survival of dogs with presumptive fibrocartilaginous embolic myelopathy[41] and degenerative myelopathy.[42] We speculate that the same would be true for dogs with medically or surgically addressed disk herniation, although careful study is needed before definitive statements are made regarding the duration of rest and the time frame to institute physical rehabilitation.

We found that glucocorticoid administration was associated with lower QOL scores and decreased odds of successful outcome. The statistical modeling controlled for potential confounding factors, such as duration of clinical signs and severity of neurologic dysfunction. The type of glucocorticoid selected, duration of glucocorticoid administration, and glucocorticoid dosage did not influence associations with QOL or success. Whereas the retrospective nature of the data collection, varying protocols for glucocorticoid delivery, and small number of cases may have influenced our results, it is also possible that glucocorticoids have a negative impact on dogs with medically managed presumptive disk herniation. The reasons for this potential negative impact are speculative, but could relate to direct effects of glucocorticoids on the spinal cord, systemic glucocorticoid side effects, or the fact that some dogs with presumptive disk herniation may have had other causes responsible for myelopathy for which glucocorticoids would be contraindicated.

The use of glucocorticoids for acute spinal cord injury and chronic myelopathy is controversial. High-dose glucocorticoids may reduce oxidative stress, inflammation, and lipid peroxidation seen in acute spinal cord injury. Despite these potential benefits, high-dose glucocorticoids, with the possible exception of methylprednisolone sodium succinate (Solu-Medrol, Pharmacia, Kalamazoo, MI), have not been shown to be a consistently effective treatment for acute spinal cord injury.[43–45] Even methylprednisolone sodium succinate, if administered at the appropriate dose and interval, offers only small improvements in neurologic function in some human studies[46–49] and has not been shown to be effective in dogs with disk herniation.[50] There is also experimental evidence that glucocorticoids may lead to excitotoxic neuronal death,[51] worsening of oxidative injury through membrane phospholipase A2 inhibition,[52] and lactate accumulation within the spinal cord parenchyma.[53] The role of low-dose glucocorticoids in chronic compressive myelopathy is even more poorly understood, with some sources suggesting that intradiscal or oral administration may be effective in humans and others indicating that this is not the case.[54–57] Although systemic side effects associated with glucocorticoids were not assessed in this study, gastrointestinal ulceration[58,59], pneumonia[60], and increased duration of hospitalization[50] have been seen with glucocorticoid use in veterinary and human patients with neurologic disease and may have played a role in outcome measures. Finally, patients in our study were not definitively diagnosed with disk herniation and some dogs may have had diseases such as infectious myelitis or diskospondylitis for which glucocorticoids might be contraindicated.

Dogs that were administered NSAIDs were more likely to have higher QOL scores ($P = .009$; OR = 2.03) when compared with those not administered these medications based on a logistic regression model. There are several potential reasons for this finding, including the analgesic effect of NSAIDs and blunted tissue inflammatory response.[61] Improved analgesia and reduced tissue inflammation have been speculated to improve mobilization and lessen disuse muscle atrophy in veterinary patients with neurologic and orthopedic disease.[62]

The potential limitations of our study include the lack of definitive diagnosis in most dogs, the reliance on respondent-based assessment of improvement in neurologic status, the use of a previously unvalidated questionnaire,

and the retrospective assignment of modified Frankel scores. Whereas signalment, history, neurologic assessment, and survey radiography can all suggest disk herniation, advanced imaging and surgical exploration are needed for definitive diagnosis. It is therefore likely that a proportion of dogs in this report had other conditions that led to paraspinal hyperesthesia or myelopathy. The methods of diagnosis we used are very similar to what several authors[13–15,63] recommend if medical management is the primary intent, and what has been used previously[16,19,64] to determine the success of medical management for presumptive disk herniation. Given that most practitioners follow diagnostic protocols similar to those we used when choosing medical management, our results are relevant in determining outcome in this patient group. Both respondent-based outcome measures and retrospective scoring of neurologic dysfunction can lead to imprecision in recorded data. Respondent-based impressions of outcome, however, do have some advantages as these individuals are probably best equipped, in our opinion, to make determinations regarding the acceptable level of disability and QOL.

In addition to the study limitations, there are a number of potential sources of bias that might have affected our results. All epidemiologic studies based on questionnaire responses are subject to selection bias if respondents are systematically different from nonrespondents (owners who chose not to complete the questionnaire). A systematic approach was used to try and reduce the potential for this problem. Although it is not possible to prove that selection bias was not present, the dogs of the respondents were not significantly different from a random subset of nonrespondents based on data available from medical records. The questionnaire was specifically designed to collect simple data from the client concerning the duration of cage rest, the owner's assessment of QOL, and the final clinical outcome. Unfortunately, errors in recall can affect all measurements and it is not possible to validate such an instrument without a prospective design or a secondary source of data. A relatively simplistic approach was chosen because of the subjective nature of the data and the inability to assess validity and repeatability. Collection of data from medical records and client assessment of outcome suggests that misclassification could have been a problem in our outcome measure and measurement of factors including administered therapy. A conservative definition of success was used to reduce subjectivity in outcome assessment and limit misclassification. Residual misclassification should be nondifferential and therefore bias our results toward the null (no association); true associations might actually be larger than measured. Residual confounding could also affect measured associations despite the use of multivariable models to control for such effects.

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APPENDIX: QUESTIONNAIRE

1. How long did you cage rest your dog for? _weeks (please fill in the number of weeks)
2. At the time of completion or discontinuation of cage rest, which statement best applies to your dog's condition

a. The dog was completely normal
b. The dog was much improved, but still weak or painful
c. The dog was the same as before treatment
d. The dog was worse than before treatment

3. If your dog was worse (see question #2) than before cage rest, was surgery performed? Circle **Y or N**
4. Since being brought home from The Emergency Animal Hospital of NW Austin on conservative therapy, has your dog had any periods after the therapy was complete where there was **worsening of weakness or coordination** or **spinal pain** (circle one or both)?
5. If the answer to #4 is yes, how many times did this happen? _(fill in)
6. If the answer to #4 is yes, how long did each of the episodes last (if more than 5 events just fill in the duration of the first 5 episodes you can recall):
   a. Episode 1 ——— days
   b. Episode 2 ——— days
   c. Episode 3 ——— days
   d. Episode 4 ——— days
   e. Episode 5 ——— days
7. If the answer to #4 is yes, were any of the periods of worsening of weakness or coordination so severe that your dog could not walk? Circle **Y or N**
8. If the answer to #7 is yes, how many times did this happen? _time
9. Has your dog had any of the following side effects that you believe may have resulted from its disk problems? **Circle Y or N next to the appropriate**
   a. Weight gain Y or N
   b. Weight loss Y or N
   c. Lethargy Y or N
   d. Chronic pain Y or N
   e. Loss of urinary continence Y or N
   f. Fecal incontinence Y or N
   g. Other–please specify_(fill in)
10. Please rate on a scale of 0–10, with 0 being unacceptable, 5 being average and 10 being excellent, how your dog's quality of life has been since conservative therapy for back pain/disk disease at The Emergency Animal Hospital of NW Austin.

    QUALITY OF LIFE_(0–10; please fill in)
11. Was your dog euthanized due to presumed intervertebral disk disease? Circle **YES** or **NO**
12. If your dog was euthanized due to presumed disk disease, how long after being discharged from The Emergency Animal Hospital of NW Austin did this occur?_days/months (circle either days or months and then fill in the appropriate number)