Risk factors for recurrence of clinical signs associated with thoracolumbar intervertebral disk herniation in dogs: 229 cases (1994–2000)

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Objective—To assess risk factors for recurrence of clinical signs associated with thoracolumbar intervertebral disk disease (IVDD) in dogs that had decompressive laminectomy without attempted prophylactic treatment of other disk spaces.

Design—Retrospective study.

Animals—229 dogs.

Procedure—Medical records of dogs that had decompressive laminectomy without prophylactic fenestration for a first episode of IVDD and were available for follow-up were reviewed. Information on 7 clinical and 8 radiographic potential risk factors were recorded.

Results—Clinical signs associated with recurrence of IVDD developed in 44 (19.2%) dogs. Ninety-six percent of recurrences developed within 3 years after surgery. Recurrence developed in 25% of Dachshunds and 15% of dogs of other breeds combined. Number of opacified disks was a significant risk factor for recurrence. Risk increased with number of opacified disks in an almost linear manner; each opacified disk increased risk by 1.4 times. Dogs with 5 or 6 opacified disks at the time of first surgery had a recurrence rate of 50%.

Conclusions and Clinical Relevance—When all likely episodes of recurrence are considered and a long follow-up period is achieved, true rate of recurrence of IVDD appears to be higher than in many previous reports. Dogs with multiple opacified disks at the time of first surgery should be considered a high-risk subpopulation. (*J Am Vet Med Assoc* 2004;225: 1231–1236)

The success of decompressive laminectomy in the treatment of **intervertebral disk disease (IVDD)** in small and large breed dogs is well documented.[1-4] Prognosis is dependent on preoperative neurologic deficits, but full recovery in a high percentage of dogs that do not have complete sensory and motor function loss can be expected. Underlying disk degeneration is a precursor to most cases of disk herniation. Disk degeneration usually involves multiple disks to various degrees in the same dog. Disk calcification seen radiographically as opacification of the disk space is a manifestation of advanced disk degeneration.[5]

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Recurrence of clinical signs attributable to other disk protrusions is likely and a relatively common clinical entity, with incidence rates reported from 2.6% to 26.5%.[1-3,6-13] Many previous studies, however, have substantial case selection bias, variable follow-up times, and small case numbers. Overall, the incidence of recurrence when the dogs in those studies are combined is 9.1% of 1,184 dogs. We hypothesized that there may be identifiable risk factors for recurrence of IVDD in dogs.

The purpose of the study reported here was to determine the incidence of recurrence of IVDD in a large population of dogs with a long follow-up period and identify risk factors for recurrence; this would allow subpopulations of at-risk dogs to be identified for possible additional therapeutic intervention at an early stage.

Criteria for Selection of Cases

Medical records of dogs that underwent decompressive laminectomy for IVDD at the University of Pennsylvania from January 1994 to December 2000 were reviewed. Only dogs that underwent a laminectomy without prophylactic fenestrations, made a full initial recovery, and were available for follow-up were included in the study. To ensure a long follow-up period, only dogs initially treated more than 2 years prior to data collation were studied. Full initial recovery was defined as the ability to walk unaided, with urinary and fecal continence.

Procedure

Clinical parameters that were reviewed included breed, age at surgery, sex, weight, body condition (grouped as overweight versus normal or underweight), postoperative neurologic recovery, recurrence of signs of pain and neurologic deficits consistent with IVDD, and details of treatment and outcome in dogs that had recurrence. All standard vertebral radiographs and myelograms taken at the time of the original surgery were reviewed by 1 of 2 radiologists (RCM, LSZ) who were unaware of any clinical data. For each disk space from T10-11 to L3-4, the following characteristics were noted: disk space opacity-calcification (present or absent), disk space size (normal or narrowed), disk space wedging (present or absent), facet joint degenerative joint disease (present or absent), facet joint size (normal or decreased), foramen opacity (normal or increased), foramen size (normal or decreased), and spondylosis (present or absent). From each myelogram, the sites of disk her-

niation were recorded in each dog. When recording the radiographic features of each disk space as described, the disk that originally herniated was excluded from the analysis.

Follow-up information was sought from the medical record or by telephone interview with the owner, veterinarian, or both. Dogs that did not develop further clinical signs of IVDD were allocated to a nonrecurrence group. Wherever possible, information regarding episodes of recurrence of signs was either gathered from the university medical record or from the local veterinarian. In cases of recurrence, clinical signs were classified into 1 of 5 previously described neurologic categories: grade 1—signs of pain only; grade 2—mild paresis, ambulatory; grade 3—paresis, nonambulatory; grade 4—paralysis; grade 5—paralysis with complete loss of sensory and motor functions.[2,11] No dogs with only recurrence of signs of back pain (grade 1) were included in the recurrence group.

Statistical analyses—A Student *t* test was used to compare age and weight of dogs in the recurrence group versus the nonrecurrence group. To compare all the clinical and radiographic parameters between the groups, the χ^2 test or Fisher exact test (for 2×2 tables) was used. Logistic regression analysis was used to calculate risk of recurrence as a function of numbers of opacified disks while adjusting for age. All statistical analyses were performed on the entire population of dogs as well as the subpopulation of Dachshunds. Data was analyzed with a statistical software program.[a]

Results

The records of 418 dogs were reviewed, of which 229 met inclusion criteria. Dogs were excluded mainly because of inability to obtain follow-up information, because they did not regain the ability to walk after the first episode of IVDD, or because they had had prophylactic disk fenestrations performed at the time of laminectomy.

Dogs had signs of various degrees of pain and neurologic deficits at the time of their first surgery. The most common breed was Dachshund (n = 87; Dachshunds and Miniature Dachshunds were grouped together for statistical purposes). Other breeds were mixed breeds (n = 44), Cocker Spaniel (17), Beagle (11), Basset Hound (10), Pekingese (8), Shih-Tsu (7), Lhasa Apso (6), Miniature Poodle (5), Pembrokeshire Welsh Corgi (5), Bichon Frise (4), German Shepherd Dog (3), Labrador Retriever (3), Pomeranian (3), Maltese Terrrier (2), Yorkshire Terrier (2), and 1 each of 12 other breeds. One hundred twenty dogs were female (94 were spayed) and 109 were male (71 were castrated). The mean age at which Bassett Hounds were affected with a first episode of disk herniation (mean, 7.97 years) was significantly (P = 0.007) greater than other breeds (mean, 5.78 years).

At the first surgery, 270 disk spaces were decompressed in 229 dogs. The most common treated disk spaces were T12-13 (n = 81), T13-L1 (55), T11-12 (42), L2-3 (41), L1-2 (29), L3-4 (19), and T10-11 (3), respectively.

Episodes of recurrence of clinical signs occurred in 44 of 229 (19.2%) dogs. Of these 44 recurrences, 20 (45%) dogs were confirmed to have a further disk herniation by use of a myelogram, surgery, or both, whereas the remaining 24 (55%) dogs were suspected to have recurrence on the basis of clinical signs but did not receive further diagnostic imaging or surgery. Of the latter 24 dogs, 13 were reexamined by a veterinarian at the time of recurrence and the remaining 11 were assumed to have had a recurrence on the basis of clinical signs described by the owner. Recurrences were categorized neurologically as grade 2 (n = 9), grade 2/3 (1), grade 3 (12), grade 3/4 (1), grade 4 (19), and grade 5 (2). Of the 11 dogs in which clinical signs suggestive of recurrence were not confirmed by a veterinarian, all but 1 dog (with paresis but ambulatory) had grade 3 deficits or worse.

Mean time from first surgery to first episode of recurrence (3 dogs had 2 recurrences, and 1 dog had 3 recurrences) was 17.3 months (range, 3 to 71 months). Eleven (25%) recurrences occurred 2 or more years after the first surgery. All dogs that underwent a second surgery had a hemilaminectomy. In 1 dog that underwent surgery, information was not

Table 1—Signalment and clinical parameters in 229 dogs with intervertebral disk herniation that recurred (n = 44) or did not recur (185) after surgical treatment.

Variable	Overall	Recurrence group	Nonrecurrence group	*P* value
Mean age (y)	5.9	5.5	6	0.31
Dachsunds (No. [%])	87 (37)	22 (50)	65 (35)	0.08
Breed type (No. [%])				0.37
Chondrodystrophic[a]	156 (89)	31 (94)	125 (87)	
Nonchondrodystrophic[a]	20 (11)	2 (6)	18 (13)	
Sex (No. [%])				0.64
Female	120 (52)	23 (52)	97 (52)	
Male	109 (48)	21 (48)	88 (48)	
Weight (range [kg])	11.3 (2.5–62)	8.9 (2.5–42.6)	11.9 (3–62)	0.21
Overweight (No. [%])[b]	87 (41)	15 (35)	72 (42)	0.49
Surgery type (No. [%])				0.27
Hemilaminectomy	205 (90)	37 (84)	168 (91)	
Dorsal laminectomy	24 (10)	74 (16)	17 (9)	

[a]Mixed-breed dogs and some purebred dogs that have not been classified as chondrodystrophic and nonchondrodystrophic in nature were excluded. [b]Not recorded for all dogs.

available on type or site of surgery. The site of second or subsequent disk herniation was confirmed at surgery in 20 dogs that had 24 recurrences: 12 dogs had a second disk herniation at a space immediately adjacent to the site of first herniation. Seven dogs had a second thoracolumbar disk herniation at least 1 space away from the original site. In 3 dogs, the same space was affected and compression was caused either by residual disk material or scarring associated with the laminectomy. In 2 dogs, the site of compression was not recorded. Twenty-eight dogs made a full recovery after the recurrence of clinical signs; 15 of these had a second surgery, whereas 13 were treated conservatively. Ten dogs were euthanatized at the time of first recurrence and 1 at the time of second recurrence. Two dogs were euthanatized after the second surgery, 2 dogs failed to recover from the second surgery, and 1 dog was lost to follow-up after the second surgery.

Mean ± SD follow-up time for dogs was 44.8 ± 21.6 months (range, 5 to 96 months). Only 15 dogs had a follow-up period of < 2 years, and 14 of these died or were euthanatized (10 because of recurrence). Another was lost to follow-up 1 year postoperatively. At the time of follow-up, 187 (82%) dogs were alive and 42 (18%) had died or been euthanatized. Mean follow-up time for all dogs that did not have recurrence was significantly ($P < 0.001$) greater than mean time to first recurrence. Mean ± SD time from first surgery to recurrence was 17.3 ± 13.1 months (range, 3 to 71 months).

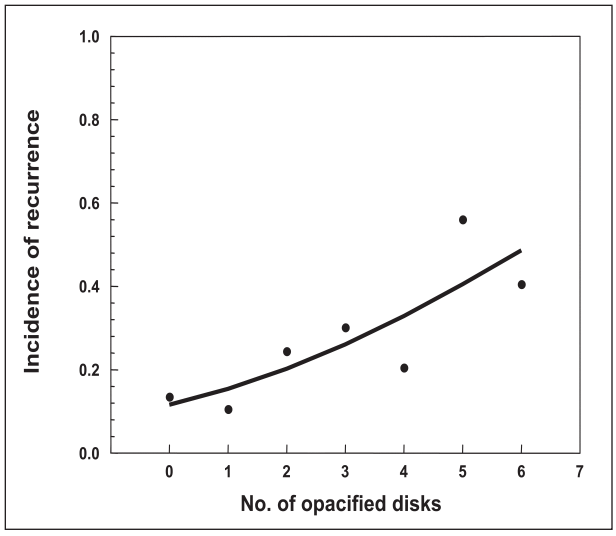

Figure 1—Logistic regression curve (solid line) of incidence of recurrence of intervertebral disk herniation as a function of number of radiographically opacified intervertebral disks in 44 dogs. Circles indicate individual datum points.

Subpopulations of dogs were identified that had a higher incidence of recurrence, compared with the general population. Twenty-five percent of Dachshunds had an episode of recurrence, compared with 15% of dogs of all other breeds combined, although this difference did not quite reach significance ($P = 0.08$). Dachshunds did, however, comprise 50% of all dogs with recurrences. Significant differences in age, sex, body condition, and surgical technique used at the first surgery between the recurrence and nonrecurrence groups were not detected (**Table 1**). A significant relationship between increasing number of opacified disk spaces and risk of recurrence was detected in the overall population (**Figure 1**; **Table 2**). With each increase in the number of opacified disks in the region of the vertebral column from the T10-11 to the L3-4 space, the risk of recurrence increased by 1.4 times. Of 17 episodes of disk herniation in which a site remote from the first episode was known to be affected, 15 of those disk spaces were previously calcified. Fifty-five percent of the nonchondrodystrophic population of dogs in this study had at least 1 calcified disk in the area from T10 to L4. There was no significant difference in any of the other radiographic features of disk spaces recorded between recurrence and nonrecurrence groups. No significant difference was found between recurrence and nonrecurrence groups when Dachshunds with ≥ 2 ($P = 0.08$) and ≥ 3 ($P = 0.1$) opacified disks were compared or in number of opacified disks per Dachshund between groups ($P = 0.07$).

Table 2—Radiographic findings (percentage of dogs affected) in 229 dogs with intervertebral disk herniation that recurred (n = 44) or did not recur (185) after surgical treatment.

Variable	Overall	Recurrence group	Nonrecurrence group	*P* value
DSO (%)[a]	66	77	64	0.11
No. of disk opacities per dog[b]	1.56	2.27	1.39	< 0.001
Dogs with ≥ 2 other DSOs (%)	45	66	40	0.023
Dogs with ≥ 3 other DSOs (%)	25	41	21	0.01
Disk space narrowed (%)	29	39	22	0.14
Disk space wedging (%)	7	11	7	0.33
Facet DJD (%)	2	5	1	0.16
Facet size decreased (%)	2	0	2	1.00
Foramen opacity increased (%)	18	21	17	0.66
Foramen size decreased (%)	12	18	11	0.20
Spondylosis (%)[c]	22	16	24	0.31

[a]Percentage of dogs with at least 1 disk space opacity other than at the site of herniation. [b]Number of disk space opacities in the T10 to L4 portion of the vertebral column, not including the site of herniation. [c]Any spondylosis on right, left, or ventral to disk.

DSO = Disk space opacity. DJD = Degenerative joint disease.

Discussion

Previous studies reviewed populations of dogs treated with a variety of medical and surgical treatments. In dogs that underwent decompressive laminectomy without prophylactic treatment of other disk spaces, recurrence rates of 2.7%,[1] 5%,[2] 6.6%,[12] 7.7%,[8] 14.6%,[3] 23%,[9] and 26.5%[7] have been recorded. The latter 2 studies had only 30 and 49 dogs, respectively, in the groups that received only decompressive laminectomy. Different combinations of surgical techniques and various follow-up times along with small case numbers in some studies have resulted in questions regarding the true incidence of recurrence of IVDD. In our study, an overall recurrence rate of 19.2% was found; several factors may account for this high recurrence rate. It has been stated that most recurrences of IVDD occur in the first 2 years after the original episode.[6] However, in some studies,[1,6,9] many dogs were lost to follow-up after 2 years. In our study, mean follow-up time was 3.7 years. To avoid underestimating the true rate of recurrence because of short follow-up periods, we deliberately chose a population of dogs that received a first surgery at least 2 years prior to data collection. Eleven dogs had a first recurrence 2 or more years after the first surgery. The incidence of recurrence would have been underestimated by 25% had only 2 years of follow-up been achieved. In our study, mean time to first recurrence was significantly less than mean time to follow-up in dogs that did not have recurrence, suggesting that a follow-up time adequate to observe recurrences had been achieved in most cases. Because 96% of recurrences developed within 3 years after the first surgery, it can be concluded that this represents the period within which almost all recurrences develop.

The recurrence group in this study included cases in which only the owners' telephone interview suggested that the dog had a recurrence of IVDD. Only 25% of suspected recurrences could not be confirmed by a veterinarian. Although all referring veterinarians were contacted for follow-up information, records of reexamination on some dogs were no longer available. There is a possibility that some of the dogs in the recurrence group that did not have imaging studies or surgery had spinal cord compression caused by a disease process other than IVDD. This may have led to overestimation of the incidence of recurrence, although we believe that this was unlikely. Most recurrences of hind limb neurologic deficit in dogs that have undergone 1 surgery for IVDD are caused by a recurrence of IVDD at a different site in the thoracolumbar vertebral column, although the effect of the first disk herniation on the site of a second or subsequent herniation is not known.[12] In instances in which the owners' description of clinical signs was used as evidence of recurrence, the owners had already witnessed 1 episode of paraparesis or paraplegia and were therefore familiar with the clinical signs.

A substantial number of recurrences of IVDD, especially if they resulted in nonambulatory paraparesis or paraplegia, resulted in owner-requested euthanasia. This may be another reason why the incidence of recurrence in this study was higher than in another study[12] in which only episodes of recurrence that resulted in a second surgery were recorded. Recurrence resulting in owner-requested euthanasia has been found in other studies.[9,11]

In the study reported here, no dogs with grade 1 signs were included in the recurrence group. We believe that signs of back pain without neurologic deficits could easily be confused with many other medical conditions, especially when relying retrospectively on the judgment of owners. For this reason, only dogs with recurrence that included some degree of neurologic deficit were included in the study. Another study[7] included these grade 1 recurrences and not surprisingly found a higher incidence of recurrence as a result.

The signalment of dogs in our study was similar to that found by others.[1-3] Dachshunds and other chondrodystrophic breeds were overrepresented (comprising 89% of the dogs) in the sample population. In our study, Dachshunds comprised half the dogs with recurrence, although they were not overrepresented in the recurrence group. Another study[12] found that Dachshunds are predisposed to recurrence. Interestingly, there was no significant difference in recurrence rates between the chondrodystrophic and nonchondrodystrophic breeds in our study. This may, however, be attributable to the small number of nonchondrodystrophic dogs in the study. Middle-aged dogs are most commonly affected with IVDD, although the age range is wide. No significant differences in age or sex between the recurrence and nonrecurrence group were found. Bassett Hounds had their first episode of IVDD at an older age (mean, 7.9 years), compared with other breeds. Perhaps this can be accounted for by slower progression or later initiation of disk degeneration in this breed. Body condition has anecdotally been linked to a higher chance of developing disk disease.[14] In our study and another,[12] no increased risk for recurrence was detected in dogs that were overweight at the time of their first episode. In our study, there were fewer overweight dogs in the recurrence group than dogs that had leaner body condition.

There was no difference in recurrence rates between dogs that underwent a dorsal laminectomy or a hemilaminectomy as a first procedure. For these 2 procedures, it is conceivable that there are different effects on the biomechanical environment at the site of previous herniation as well as on adjacent spaces that could affect the pattern of subsequent disk herniations. No such effect was seen in our study, but a difference could have gone undetected because of the small number of dogs that underwent dorsal laminectomy.

Review of the radiographs taken at the time of first surgery revealed that certain features of unherniated disk spaces may be predictive of risk for recurrence. Disk space opacity, which is mainly a manifestation of calcification, was a significant risk factor for recurrence. Disk calcification is reported to be more common in chondrodystrophic breeds,[5] although in our study, 55% of the dogs of the nonchondrodystrophic breeds had at least 1 other calcified disk in the thoracolumbar portion of the vertebral column; it appears that disk calcification in nonchondrodystrophic breeds

is not uncommon but may simply occur much later than in chondrodystrophic breeds.

Previous studies[15-17] have attempted to assess the incidence of disk calcification in dogs. Disk calcification can be seen as early as 6 months of age in chondrodystrophic dogs, but numbers of calcified disks peak at 18 to 24 months.[15] As many as 31% of calcified disks will actually decalcify and return to normal radiographic appearance by 5 years of age.[17] Mean age of dogs in our study was 5.85 years. It is therefore likely that most disks that were destined to calcify had done so in the dogs in our study, and in older dogs, some previously calcified disks may have been decalcified. To adjust for this possibility, age was included in the logistic regression model. However, age was not a significant factor with regard to disk opacification and outcome. Postmortem analysis of disks has revealed a much greater incidence of degeneration and disk calcification than is evident radiographically,[5] which indicates that the number of calcified disks is underestimated when evaluated only radiographically.

Our study revealed a close relationship between the number of radiographically calcified disks and the risk of recurrence. As the number of radiographically calcified disks increased, there was an almost linear increase in incidence of recurrence. In dogs with 5 or 6 other calcified disks detected at the time of first surgery, the recurrence rate was 50%. The prevalence of other radiographic parameters did not differ significantly between the 2 groups. Analysis of data on Dachshunds alone was done because they represent a more homogeneous population of dogs at high risk for IVDD. However, in the specific subsets of Dachshunds with ≥ 2 or ≥ 3 opacified disks, of which there were relatively small numbers, no significant difference was detected between the recurrence and nonrecurrence groups. There was also no difference in numbers of calcified disks per dog between the recurrence and nonrecurrence groups, although the *P* value approached significance. Nevertheless, we believe it is possible that a relationship exists between disk calcification and recurrence of IVDD in Dachshunds.

Most episodes of recurrent paraparesis or paraplegia are caused by herniation of a second disk somewhere in the thoracolumbar vertebral column. This is especially true when the episode of recurrence occurs more than 1 month after the original surgery.[12] Most cases that recur prior to this are caused by residual disk material at the site of the original lesion.[12] In the present study, mean interval to recurrence of neurologic signs was 17.3 months with a range of 3 to 71 months. In 19 of 22 dogs in which the cause of recurrence was evaluated surgically, disk herniation had occurred at a site different from the original site. In 88% of dogs in which the site of subsequent disk herniation was known, disk calcification had been detected previously at the site of the second and third herniations. This is further evidence that clinical importance should be given to disk calcification at the time of first surgery.

Much debate has surrounded the use of prophylactic disk fenestration to reduce the recurrence of disk herniation either from residual disk material at the site of first herniation or from other disk spaces at a later date. In some reports,[1,2] it has been suggested that a recurrence rate of 2% to 5% does not warrant the extra risk and potential complications that disk fenestration may cause. However, some authors have detected a difference in recurrence between fenestrated and nonfenestrated populations, albeit often with small case numbers.[8,9] Because the incidence of recurrence appears to be substantially higher than previously believed, there are 2 factors that must be considered if fenestration is to be recommended routinely: the incidence of recurrence that is considered acceptable and whether fenestration is truly effective in preventing recurrence and worth the additional time and potential complications. It appears from our study that euthanasia is commonly chosen by owners in cases of recurrence, and for that reason, minimizing recurrence is desirable. However, it also appears that recovery to ambulation after a second episode occurs in most dogs, and there is no difference in the proportion of dogs that recover to ambulation after either the first or second episode if surgery is pursued on both occasions.[12] Hypothetically, because prognosis is good for the 19.2% of dogs that suffer a second episode of IVDD, performing a second decompressive surgery on only this subgroup of dogs may be preferable to performing unnecessary fenestrations in the other 80.8% of dogs that were never destined to have a recurrence. Evidence for the effectiveness of fenestration in prevention of IVDD recurrence is variable. Part of the problem may be that effectiveness of fenestration appears to be dependent on surgical technique.[18,19] Prophylactic fenestration does not guarantee avoidance of recurrence.[7,20] A recent study[21] involving a large number of dogs, most of which were treated with fenestration at the time of first surgery, revealed a surgically confirmed recurrence rate of only 4.15%, although in a second phase to the study, telephone follow-up revealed that 15.8% of 114 owners questioned stated that their dogs had recurrence of clinical signs of IVDD confirmed by a veterinary examination. This rate of recurrence does not differ greatly from the 19.2% recurrence rate found in this study. Another study[22] revealed a recurrence rate of 3.4% in dogs that underwent percutaneous laser disk ablation, although the mean follow-up time was only 15.1 months.

The subpopulation of patients with many calcified disks in the thoracolumbar vertebral column should be considered at high risk for recurrence. This group of patients should form a basis for further study of prophylactic measures such as disk fenestration. It remains for a well-designed, long-term prospective study to determine whether prophylactic procedures performed either in addition to decompression or as a sole procedure in dogs with many calcified disks but mild clinical signs significantly reduces the recurrence of clinical IVDD or the numbers of animals that are euthanized as a consequence.

[a]SAS, version 8.1, SAS Institute Inc, Cary, NC.

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