

Recurrence of signs consistent with cervical intervertebral disc extrusion in dogs

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OBJECTIVES: Report the rate of recurrent clinical signs following successful treatment of cervical intervertebral disc extrusion, and explore the association between treatment method and recurrence.

MATERIALS AND METHODS: Medical records of dogs with MRI- or CT-confirmed cervical intervertebral disc extrusion were reviewed to verify that they recovered. Type of treatment, site of initial extrusion and whether dogs re-presented with recurrent clinical signs were recorded. Recurrence was considered presumed if based on clinical signs or confirmed if based on repeat cross-sectional imaging.

RESULTS: Complete recovery was documented following medical (36/119, 30.3%) or surgical (83/119, 69.7%) management of initial cervical disc extrusion. There was a recurrence of consistent clinical signs in 40 of 119 (34%) cases, of which 27 of 83 (33%) were initially managed surgically and 13 of 36 (36%) medically. In 24 of 40 (60%) cases, there was imaging confirmation of recurrent extrusion; in medically managed dogs, recurrence mostly occurred at the same site, whereas after surgery, recurrence most commonly involved an adjacent disc. Of the 40 recurrences, 32 (80%) occurred within 2 years of diagnosis. Rate of recurrence was similar between treatment methods in both univariable and multivariable time-to-event analyses (hazard ratio 1.03; 95% confidence interval: 0.67 to 1.53; P=0.87).

CLINICAL SIGNIFICANCE: Following successful initial medical or surgical treatment, clinical signs consistent with recurrent cervical disc extrusion occurred with similar frequency. Medically treated cases tended to have recurrence at the same site as initial presentation, whereas surgical treatment prevented this. Recurrence usually occurred within 2 years. The retrospective study design, small number of recurrences and lack of imaging confirmation of every recurrence should be considered when interpreting the results.

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INTRODUCTION

Intervertebral disc herniation is the most common spinal disorder of the dog, with the cervical region accounting for up to 25% of these cases (Brisson 2010). The most common type of intervertebral disc herniation is often described as “Hansen type 1 intervertebral disc extrusion (IVDE)” (Hansen 1952, Kranenburg *et al.* 2013,

Hansen *et al.* 2017), in which the degenerate and calcified nucleus pulposus escapes through a tear in the annulus fibrosus. This leads to spinal cord compression and contusion, and associated inflammation of the meninges. The most common clinical sign relating to cervical IVDE is cervical pain, with neurological deficits being less common than with disc extrusions in other parts of the vertebral column (Cherrone *et al.* 2004); one study reported ~85% of

dogs with cervical IVDE were presented for cervical hyperaesthesia alone (Ryan *et al.* 2008). Chondrodystrophic breeds are genetically predisposed to IVDE (Packer *et al.* 2013, Brown *et al.* 2017) and tend to be younger at presentation than non-chondrodystrophic breeds. Dogs tend to have their first cervical IVDE between the ages of 3 and 8 years, with one study reporting a mean age of 7.8 years (Cherrone *et al.* 2004, Smolders *et al.* 2013).

Dogs with cervical IVDE may be treated medically or surgically; medical management involves a period of strict confinement alongside appropriate analgesia. Surgical management currently involves decompression of the spinal cord *via* a “ventral slot” procedure or alternative approach to the vertebral canal. It has been reported that medical management of cervical IVDE is not as successful at resolving clinical signs in dogs and that recurrence rates may be higher (Russell & Griffiths 1968, Denny 1978, Levine *et al.* 2007, Brisson 2010). However, surgery can be associated with both major and minor adverse events. One study reported that 9.9% of dogs had at least one adverse event that significantly affected the length of their hospitalisation and half of these dogs required a second surgery (Rossmeisler *et al.* 2013).

This retrospective study aims to report the rate of recurrence of clinical signs consistent with cervical IVDE following successful treatment of an initial confirmed cervical IVDE, and to explore whether there was an association between treatment method and recurrent clinical signs.

MATERIALS AND METHODS

Medical records at two veterinary hospitals were searched for dogs that had cross-sectional imaging [MRI (APERTO Lucent, Hitachi, 0.4T or 0.27T permanent magnet, Esaote VetMR Grande, Italy) or CT (second-generation DSCT, Somatom Definition Flash; Siemens, Erlangen, Germany)] to confirm a cervical intervertebral disc herniation, suspected (or confirmed at surgery) to be an extrusion. An extrusion was defined on MRI by the commonly accepted imaging criteria described by De Decker *et al.* 2016; in particular, the presence of a single intervertebral disc herniation where disc material has spread beyond the affected IVD space. CT has very high sensitivity for detecting IVDEs through the detection of even small amounts of extradural calcified material (Stigen *et al.* 2019). Data were available from January 2006 to December 2017 with each dog followed up for a minimum period of 6 months. Inclusion criteria were dogs <20 kg that had MRI or CT confirmation of a cervical IVDE, and for which data on complete initial management and follow-up were available. Any dog in which the clinical and neurological examinations were not consistent with cervical IVDE or imaging or surgical findings ruled out cervical IVDE were excluded. While a relatively arbitrary cut-off weight, we excluded dogs weighing >20 kg, on the basis that Hansen type 2 protrusions are more common in larger, non-chondrodystrophic breeds, particularly in the cervical region. No attempt was made to distinguish between acute and chronic extrusions.

The age, breed (including chondrodystrophic status), sex and weight of dogs were recorded. The majority of dogs were cross-breeds. Chondrodystrophy was defined according to the list of

breeds associated with the FGF4-12 and FGF4-18 mutations by Laboklin Laboratory for Clinical Diagnostics (LABOKLIN, 2007; www.laboklin.co.uk) and Canine HealthCheck (2019; www.caninehealthcheck.com). The location of initial disc extrusion was also recorded along with how each dog was treated. Two treatment options were used: (1) *surgery*, consisting of decompression *via* “ventral slot” partial corpectomy and (2) *medical management*, by restriction of activity and non-steroidal analgesics. Where possible, the original presenting signs were recorded and the cases were grouped into “neck pain only”; “ambulatory tetraparesis” or “non-ambulatory.” Data on follow-up were extracted from electronic medical records at the participating clinics where available; and otherwise from the owners or the referring veterinarian records. A dog was considered to have recovered if records showed that the presenting clinical signs remained resolved at a time-point of at least 1 month after initial presentation. Any dog for which a full initial recovery could not be confirmed was excluded from the study.

Two types of recurrence were documented; “presumed cervical IVDE recurrence” was defined as clinical signs deemed consistent with cervical IVDE by a veterinarian, and “confirmed cervical IVDE recurrence” were those confirmed by cross-sectional imaging. The most common sign associated with cervical IVDE is cervical hyperaesthesia, which might manifest as guarding of the neck, muscle fasciculations or reaction to palpation over the neck. Less common clinical signs of cervical IVDE include proprioceptive ataxia and tetraparesis (Brisson 2010). In confirmed recurrences, the location of the new disc extrusion was recorded. In all cases, treatment of the recurrent signs and whether an affected dog recovered the second time was documented. Some dogs had a second recurrence, in which case the same information was recorded, but not included in the statistical analysis.

Statistical analysis

Statistical analysis was performed on Microsoft Excel for Office 365 MSO and Stata 14 (StataCorp, College Station, TX). Most of the statistics were descriptive, with median (and range) values used for many group comparisons. In an exploratory analysis, incidence of recurrence in medical and surgical groups was compared using univariable and multivariable Cox proportional hazards regression (thus taking into account the variable length of follow-up), using $P < 0.05$ to suggest significant findings.

RESULTS

One hundred nineteen dogs met the inclusion criteria for the study with 27 dog breeds included. Breeds that were represented by five or more individuals included crossbreeds [39 dogs (32.8%)], French bulldog [14 dogs (11.8%)], dachshund [10 dogs (8%)], miniature pinscher [nine dogs (7.6%)], beagle [eight dogs (6.7%)] and English cocker spaniel [five dogs (4.2%)]. For the full list of breeds, see Appendix. The median age of dogs at initial presentation was 101 months (range 13 to 206 months). The median bodyweight was 9.5 kg. Eighty-one (68.1%) dogs were male (62 male entire, 19 male neutered) and 39 (32.7%) dogs were female (10 female entire, 29 female neutered).

There were 125 disc extrusions at initial presentation. Of 119 dogs, 110 (92%) underwent CT scan, and the remainder dogs underwent MRI. Six dogs presented with two disc extrusions each; in these cases, it might be more likely that one was acute and the other was chronic, but this could not be confirmed in five dogs because they were treated medically. In the surgically managed case, two disc extrusions were confirmed but it was not possible to determine their time of onset. Overall, the most common site for disc extrusion at initial presentation was C2 to C3 and C4 to C5 (27 disc sites each, 22%), but there was almost an equal number of extrusions at each space between C2 and C6 (see Fig 1).

Dogs were treated either with medical management (36 dogs and 41 disc sites) or surgery (83 dogs and 84 disc sites). Demographics and clinical presentations were similar between groups (see Tables 1–3). All surgically treated dogs underwent ventral slot decompression without prophylactic fenestration of other disc spaces.

Recurrence of clinical signs of cervical IVDE

In total, 40 (34%) dogs had a recurrence of clinical signs, occurring between 1 and 112 months following initial treatment (see Fig 2). Although a full neurological examination was not always recorded, abnormal findings were detailed in the clinical history, allowing inclusion by clinical signs. Twenty-seven of 83 (33%) dogs that were treated surgically and recovered from their first disc extrusion exhibited recurrent clinical signs, compared with 13 of 36 (36%) dogs that were initially treated medically (Table 4). In exploratory univariable Cox regression analysis, the probability of recurrence was similar between groups [hazard ratio (HR), for surgical *versus* medical therapy, was 1.03; 95% confidence interval (CI): 0.67 to 1.53; P=0.87]. Multivariable analysis, in which age, weight, chondrodystrophy, neurologic grade at initial diagnosis (gender and neuter status were included as covariates) did not substantially alter this relationship (HR=1.05; 95% CI:

0.69 to 1.60; P=0.81). The results were also summarised in a Kaplan–Meier plot (Fig 3).

The clinical sign that suggested recurrence throughout all cases treated medically or surgically was a description of pain, either “neck pain”, “stiff neck” or a description of nerve root signature. Other signs, such as varying degrees of tetraparesis, proprioceptive deficits or depressed thoracic limb reflexes were detected in 34% of cases (11/32). In similar proportions to dogs presenting with a cervical IVDE, 68% of dogs with recurrent signs of cervical IVDE were male (17 male entire and 10 male neutered) and 33% were female (four female entire and nine female neutered). The median age and weight of dogs at initial presentation that subsequently had at least one recurrence of signs were 93.5 months and 8.8 kg, respectively. Twenty-two (55%) dogs that had recurrence showed clinical signs within a year and 32 (80%) dogs within 2 years. The incidence of recurrence within the first year for all surgically managed cases was 18% (15/83) and for medically managed cases, it was 19% (7/36). Follow-up time data were normally distributed. The mean follow-up time for medically managed cases was 46.3 months with standard deviation 24.2; for surgically managed cases, it was a similar mean follow-up of 46.9 months, standard deviation 30.5. The most common site of recurrence overall was at C5 to C6 (five medically managed dogs and four surgically managed).

Recurrence of a cervical IVDE was confirmed with cross-sectional imaging in 60% of dogs with recurrence (24/40 dogs) and 20% of the entire population (24/119 dogs). Of these 24 dogs, 10 were managed medically for their recurrence, and 12 were surgically managed (when the extrusion was confirmed). In two dogs, the treatment of their recurrent clinical signs was not recorded. In 14 of 24 (59%) dogs, imaging revealed that the recurrent cervical IVDE was either of an adjacent IVD (nine dogs) or the same IVD as the initial diagnosis (five dogs). Out of the eight dogs treated initially with medical manage-

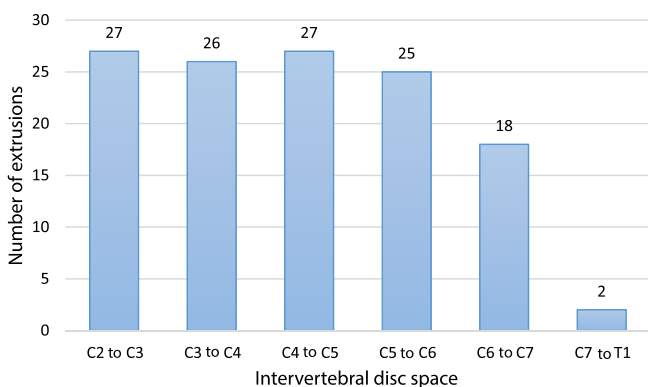


FIG 1. A graph to show the number of disc extrusions at each intervertebral disc space

Table 2. Comparison of sex of dogs treated medically and surgically

	Medical (%)	Surgical (%)
Female Entire	11.1	7.2
Female Neutered	19.4	25.3
Male Entire	55.6	50.6
Male Neutered	13.9	16.8

Table 3. Comparison of initial presenting signs of dogs treated medically and surgically

	Neck pain only, n (%)	Ambulatory tetraparesis, n (%)	Non-ambulatory, n (%)	Total
Medical	15 (45)	16 (48)	2 (6)	33
Surgical	26 (35)	39 (52)	10 (13)	75

Table 1. Overview of demographics in dogs treated medically and surgically

	Median age (months)	Median weight (kg)	Chondrodystrophic dogs (%)	Sex (%)				Top 2 breeds
				Female Entire	Female Neutered	Male Entire	Male Neutered	
Medical	110.5	8.9	63.9	11	19	56	14	Crossbreeds, French bulldog
Surgical	97	9.8	61.4	7	25	51	17	

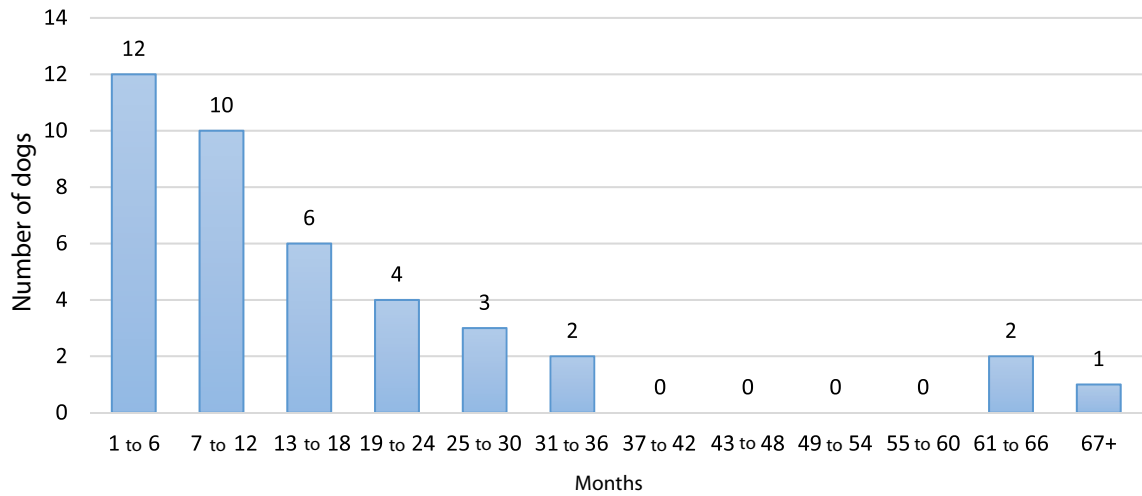


FIG 2. A graph depicting time to recurrence, in months

Table 4. Summary of recurrences

Treatment	Overall recurrence rate	Recurrence rate over 24 months	Median time to recurrence (months)	Recurrence at same site	Recurrence at adjacent site
Medical	36%, 13/36 dogs	28%, 10/36 dogs	13	50%, 4/8 dogs	0%, 0/8 dogs
Surgical	33%, 27/83 dogs	27%, 22/83 dogs	10	6%, 1/16 dogs	56%, 9/16 dogs

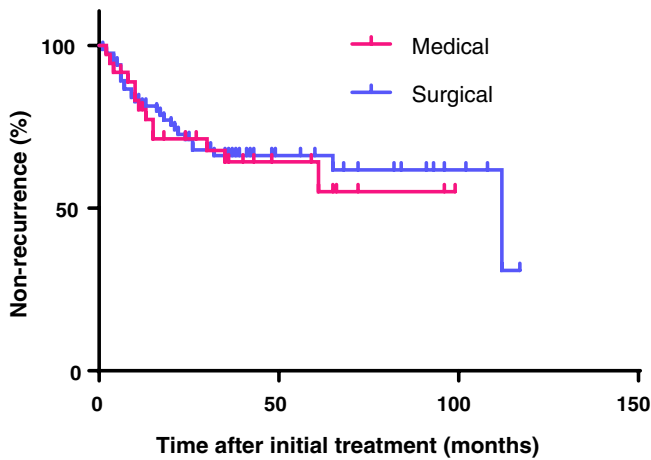


FIG 3. A Kaplan–Meier graph depicting the probability of recurrence after initial treatment in dogs treated medically and surgically

ment, four showed recurrence at the same IVD site. In contrast, there was recurrence at the same site in one of the 16 initially surgically managed cases and this occurred more than 5 years after the initial extrusion. However, out of the 16 dogs that were initially treated surgically, nine (56%) had a recurrent cervical IVDE at an adjacent disc site, whereas none of the eight medically managed dogs had a recurrent disc at an adjacent site.

Further recurrence

Twelve of 40 (30%) dogs had at least one further recurrence. Of these, six (50%) had been medically managed for their first recurrence and four (33%) surgically managed at their first recurrence. The prior management of two dogs with a second recurrence was unknown. Four dogs had further imaging to confirm the second

recurrence, with two disc extrusions at C2 to C3 and one each at C3 to C4 and C5 to C6.

DISCUSSION

Overall recurrence rate of clinical signs consistent with cervical IVDE in this study was ~34% (40/119), in line with previous reports. Recurrence rates of up to 40% following medical management of cervical IVDE have been previously reported, compared with less than 10% following surgical management (Russell & Griffiths 1968, Janssens 1985, Cherrone *et al.* 2004, Levine *et al.* 2007). Imaging-confirmed recurrences were more common at the same site in medically treated dogs, as expected, whereas surgically treated dogs almost exclusively exhibited recurrence at another (usually adjacent) site. Our results suggest that surgical treatment of IVDE essentially eliminates the risk of IVDE at the same site, but there is no indication that surgery reduces the overall risk of recurrent clinical signs. Nevertheless, some caution is required in interpreting our data since only a relatively small number (40/119) of recurrences were observed, thereby implying low study power, and additionally, 40% of these cases did not have repeat imaging.

It might be unsurprising that half of recurrences occurred at the same (unoperated) site as the initial cervical IVDE in medically managed dogs. In this study, of eight dogs managed medically, which had imaging-confirmed recurrence, four had recurrence at the same disc site as the initial extrusion. Of the 16 surgically managed dogs in which recurrence was documented by imaging, just one occurred at the operated site and this was 5 years later. This was an unusual case of a 5-year-old dachshund that had a C2–C3 disc extrusion in December 2010 and then had

a recurrence in May 2016, with an imaging diagnosis of another disc extrusion at the same level. This was medically managed, and signs resolved. Whilst this would seem unlikely following ventral slot, recurrence of signs associated with extrusion of further nucleus pulposus material at the site of ventral slot decompression has previously been reported (Cherrone *et al.* 2004, Rossmel Jr *et al.* 2013). It is also important to consider that, because the recurrent cervical IVDE in this case was diagnosed on CT, there is a possibility that another relevant intramedullary lesion was overlooked. MRI is known to be a more sensitive modality for detecting small or subtle spinal cord lesions, but 92% of our cases (110/119 dogs) instead underwent a CT scan to diagnose their initial disc extrusion. CT is described as highly reliable for diagnosing IVDE (da Costa *et al.* 2020), but it is possible that subtle intramedullary lesions on initial imaging could have been missed, which is a relevant factor when considering further limitations of our study. Interestingly, nine of the 16 cases that had recurrent signs and were initially managed surgically had the recurrent disc extrusion at an adjacent disc site, whilst this occurred in none of the medically managed cases.

Our aim was to include Hansen type 1 extrusions only and exclude Hansen type 2 protrusions. For this reason, we limited inclusion to dogs <20 kg in order to exclude the larger breeds (including Dobermanns, Labradors and Dalmatians) known to be predisposed to caudal cervical intervertebral disc protrusions. Whilst it is known that small breeds can also suffer from intervertebral disc protrusions (Schmied *et al.* 2011) – and larger breeds may also suffer acute type I extrusions (Cherrone *et al.* 2004, Gomes *et al.* 2016), a combination of imaging findings and confirmation at surgery meant we were able to be as certain as possible regarding the initial diagnosis of IVDE in our population of cases. The most common breeds in the study reflect those included in most studies of this nature, with chondrodystrophic breeds representing over half of all dogs (Packer *et al.* 2013).

Recurrence in this study was defined as the development of new clinical signs deemed most likely secondary to cervical IVDE by a veterinarian, after documented recovery from an initial cervical IVDE. After understanding what type of treatment is most likely to improve their dog's initial signs, owners often want to know if their dog will be affected with the same or similar clinical signs in the future, and if this could be influenced by the initial treatment. Our focus on recurrence of *clinical signs* means that we cannot be certain that all recurrences were in fact due to disc extrusions. Although presumed recurrence based on appropriate clinical signs has been used in many other studies (Levine *et al.* 2007, Aikawa *et al.* 2012, Brisson *et al.* 2011, Kerr *et al.* 2021), imaging confirmation of every recurrence would provide a different set of data. We considered that determining recurrence of clinical signs would be of practical value to owners and, furthermore, could more accurately be answered in the veterinary context because of the inherent problems with accruing complete datasets that depend on owner finances. Reasons for failure to investigate recurrence may include lack of available funds, clinical signs deemed mild enough to treat presumptively or reluctance of owner for further invasive treatment.

Pain is a common clinical sign of several conditions of the cervical spine, and this was the most frequent sign used to indicate presumed recurrence of IVDE. Clearly, although we aimed to report the rate of recurrence of consistent clinical signs of IVDE following successful initial treatment, a limitation of our study is that we cannot exclude the possibility that some cases had other conditions than IVDE. Our intention was to achieve a high level of confidence that a recurrent disc extrusion was the *most likely* diagnosis in this population of dogs by (1) including only dogs that weighed less than 20 kg, (2) excluding dogs with a history of trauma and (3) including cases that were treated only with medical management (crate rest, restricted exercise and analgesia) that did not target specific conditions, such as infection or inflammation. Whilst there are conditions, such as syringomyelia, that can be waxing and waning and could respond intermittently to medical management, a history of a previous IVDE diagnosed with cross-sectional imaging, plus the older age of dogs and low numbers of the most predisposed breeds, made this an unlikely cause of recurrent clinical signs in our population. The intention with our study was to avoid potentially overlooking a large number of genuine recurrences; we are aware that in so doing, we may have overestimated the prevalence of disc-associated recurrence of clinical signs, but feel that insistence on imaging-documented recurrence only would have generated a different data set and is for a study with different aims.

Fenestration of intervertebral discs in the thoracolumbar region reduces the risk of IVDE. One study reported that the likelihood of thoracolumbar disc extrusion was 26.2 times higher in non-prophylactically fenestrated discs (Aikawa *et al.* 2012), and a formal trial demonstrated a reduction in recurrence rate from 17 to 7% by prophylactic fenestration of six discs at the time of decompressive surgery in the thoracolumbar region (Brisson *et al.* 2011). Similar studies have not been carried out in the cervical region, and many surgeons do not routinely prophylactically fenestrate in the cervical region perhaps in part due to reports of complications causing neurological deterioration (Sterna & Burzykowski 2008). In our study, surgically managed cases showed a trend towards recurrent signs associated with extrusion at an adjacent disc site. As such, it remains unclear whether fenestration, performed alongside appropriate decompressive surgery, would be both safe to perform and helpful in preventing recurrent cervical IVDEs at adjacent sites (Denny 1978, Sterna & Burzykowski 2008).

Over half of the dogs (55%) in this study that suffered a recurrence of clinical signs consistent with cervical IVDE had their first recurrence within a year, and 80% within 2 years. When recurrence of a cervical IVDE was confirmed to be at the same disc site as the original extrusion (almost exclusively in medically managed patients), it occurred 4 months or longer following the first extrusion. Interestingly, in the thoracolumbar region, it is thought that the same disc is likely to re-extrude within a month, and later recurrences are more likely to be a new disc (Dhupa *et al.* 1999).

The overall rate of recurrent clinical signs following initial successful management of cervical IVDE in this population of small and medium breed dogs was 34% (40 of 119 dogs) with a mean

follow-up of 47 months. A smaller number of dogs had cross sectional imaging to confirm a second extrusion, which confirmed recurrence in 20% of the total population. Recurrence rate was similar between initial medical and surgical management, albeit based on a small total number of cases, but recurrences in medically managed dogs tended to occur at the same site as initial extrusion whereas surgically managed dogs showed recurrence at other sites. About half of all recurrent clinical signs occurred within a year, and the majority were within 2 years.

Conflict of interest

None of the authors of this article has a financial or personal relationship with other people or organisations that could inappropriately influence or bias the content of the paper.

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A APPENDIX

The other breeds were shih-tzu (four), Pekingese (four), Whippet (three), miniature poodle (three), two each of Yorkshire terrier, miniature schnauzer, Maltese, Chihuahua; one each of West Highland White Terrier, Toy poodle, springer spaniel, Patterdale terrier, medium poodle, Japanese Chin, Jack Russell terrier, Cavalier King Charles spaniel, Brittany spaniel, Boston terrier, Azawakh, American cocker spaniel.