Comparative study of vertebral fractures and luxations in dogs and cats

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Summary
The purpose of this retrospective study was to compare patterns of vertebral fractures and luxations in 42 cats and 47 dogs, and to evaluate the impact of species-related differences on clinical outcome. Data regarding aetiology, neurological status, radiographic appearance and follow-up were compared between the groups. The thoracolumbar (Th3-L3) area was the most commonly affected location in both cats (49%) and dogs (58%). No lesions were observed in the cervical vertebral segments in cats, and none of the cats showed any signs of a Schiff-Sherrington syndrome. Vertebral luxations were significantly more frequent in dogs (20%) than in cats (6%), whereas combined fracture-luxations occurred significantly more often in cats (65%) than in dogs (37%). Caudal vertebral segment displacement was mostly dorsal in cats and ventral in dogs, with a significant difference in direction between cats and large dogs. The clinical outcome did not differ significantly between the two populations, and was poor in most cases (cats: 61%; dogs: 56%). The degree of dislocation and axis deviation were both significantly associated with a worse outcome in dogs, but not in cats. Although several differences in vertebral fractures and luxation patterns exist between cats and dogs, these generally do not seem to affect outcome.

Keywords
Vertebral fractures, vertebral luxations, cats, dogs

Vet Comp Orthop Traumatol 2009; 22: 47–53

Prepublished online: December 10, 2008
doi:10.3415/VCOT-08–02–0018

Introduction

Spinal trauma is a common cause of spinal cord dysfunction in dogs and cats and frequently involves vertebral fractures, luxations or subluxations, depending on the animal's position on impact, the type of force conveyed, the area of impact and inherent strengths and weaknesses of the vertebral column (1). Vertebral fractures and/or luxations account for 6% of all spinal cord disorders in cats (2) and 7% of all neurological disorders in dogs (3). In most cases, these result from motor vehicle accidents or falls, but bite wounds, gunshot wounds and other causes are also described (4–7). A number of studies have reviewed vertebral fractures and/or luxations in dogs, cats or mixed populations (4–8), but none of these have focused on the similarities or discrepancies in lesions between the two species. One paper (8) looked into the radiographical variations of vertebral fractures and/or luxations between dogs and cats but failed to compare these findings with clinical outcome. They found that the lumbar area was most commonly affected in dogs (39%) and the sacrocaudal segment in cats (46%). The purpose of the present study was to analyse the differences of vertebral fracture and/or luxation patterns between dogs and cats and their influence on clinical outcome.

Materials and methods

The medical records of dogs and cats with vertebral fractures and/or luxations, that had been admitted to our institution between September 1998 and January 2007, were reviewed. Animals with caudal fractures and/or luxations or sacrocaudal luxations were not included in the study. The data obtained from the records included signalment, cause of injury, time elapsed before presentation (<24 h, >24 h), concurrent injuries and mode of treatment (conservative, surgical stabilisation or none [euthanasia within the first 24 hours after presentation]). Information about the neurological status upon admission and at least one lateral radiograph were required for inclusion in the study. The patients were categorized by age as older or younger than 12 months, and the dogs were further subdivided into animals weighing more (large) or less (small) than 15 kg. Each case was clinically graded based on the severity of neurological dysfunction into one of five groups (I = pain only; II = proprioceptive deficits and/or ambulatory para-/tetraparesis; III = non-ambulatory para-/tetraparesis; IV = para-/tetraplegia; V = para-/tetraplegia with loss of deep pain perception) (9). The least noxious stimulus possible was used to assess deep pain perception, and a haemostat was used to apply pressure across a digit only when a response could not be easily elicited otherwise. In animals showing doubtful reactions to stimulation, deep pain perception was considered absent. Micturition dysfunction and presence of Schiff-Sherrington syndrome were also noted.

All of the radiographs were evaluated by a single investigator (M.S. Bali). The lesions were classified according to their location within the vertebral column (C1-C5, C6-Th2, Th3-L3, L4-L7, S1-S3). The L4-S3 location was arbitrary separated into L4-L7 and S1-S3 due to the marked differences in clinical presentation. The lesions involving the segment borders (C5/C6, Th2/Th3, L3/L4, L7/S1) were included in the associated cranial segment (e.g. lumbosacral luxations in the L4-L7 group). Fracture and/or luxation type was categorized using a modification of the classification system of spinal trauma described by Shores (10). Therein, the

Received: February 18, 2008
Accepted: May 2, 2008

lesions were classified as hyperflexion injuries, hyperextension injuries, subluxations, luxations, fracture-luxations, transverse fractures, and burst- or wedge compression fractures. Because of the similarities in their aetiopathogenesis, we combined the latter two into a single category (wedge compression fractures) (Table 1). Traumatic disc disease could not be differentiated from subluxations due to a lack of further diagnostic imaging (CT, MRI, myelography). In our study, the two-compartment-concept was applied (11). The dorsal compartment consists of the vertebral lamina, together with its associated processes and ligamentous structures, and the ventral compartment is composed of the vertebral body, the intervertebral disc and the dorsal and ventral longitudinal ligaments. The degree of dislocation in the sagittal plane was assessed by calculating the degree of displacement of the vertebral canal and ranged from 0 to 100% (Fig. 1). Axis deviation was determined as the acute angle between the long axis of the cranial and the long axis of the caudal segment (Fig. 2). Rotation of the caudal to the cranial segment was subjectively assessed by the position of the spinous processes on the ventrodorsal views and the ribs or transverse processes on the lateral views. The intervertebral disc space was defined as normal or abnormal (visible dislocation, increased or decreased width) and displacement of the caudal vertebral segment was classified as ventral or dorsal. Furthermore, end plate involvement (end plate-fractures and end plate-physeal fractures) was assessed.

A follow-up by telephone interviews was carried out in all of the cases that were initially discharged from the hospital. 'Poor' outcome was defined as death, euthanasia due to grave prognosis, lack of improvement in neurological status and/or permanent dysfunction of micturition. 'Functional outcome' was defined as a marked improvement in neurological status (resolution of pain and/or improved ambulation with normal micturition). An excellent outcome was defined as a normal neurological status at the time of follow-up.

Table 1 Localisation, fracture classification (modified after Shores 1992) and radiographic findings of 49 feline and 59 canine vertebral fractures and luxations observed in 42 cats and 49 dogs. For the localisation lesions were classified according to their vertebral column localisation. Vertebral displacement was present in 37 feline and 38 canine fractures and luxations.

		Cats %	Dogs %		
			Total	Small dogs	Large dogs
		n = 49	n = 59	n = 32	n = 27
Localisation					
C1-C5		0	3	3	4
C6-Th2		0	9	13	4
Th3-L3		49	58	59	56
L4-L7		33	24	13	37
S1-S3		18	7	13	0
Classification					
Hyperflexion injury		0	0	0	0
Hyperextension injury		4	5	6	4
Wedge compression fracture		12	7	9	4
Subluxation		6	14	6	22
Luxation		6^{a}	20^{b}	13	30^{b}
Fracture-luxation		65^{a}	37^{b}	34^{b}	41
Transverse Fx		8^{a}	17	31^{b}	0^{a}
Radiographic findings					
Compartments involved	Dorsal	8	17	31^{a}	0^{b}
	Ventral	20	24	19	30
	Both	72	59	50	70
Endplate	Physeal Fracture	16	10	13	7
	Fracture	37	22	22	22
Rotation		53	44	34	56
IVSP-involvement		53^{a}	64	47^{a}	85^{b}
		n = 42	n = 47	n = 21	n = 26
Multiple Fx/Lx		12	15	29^{a}	4^{b}
		n = 37	n = 38	n = 16	n = 22
Direction of vertebral displacement	Dorsal	65^{a}	37	50	27^{b}
	Ventral	35^{a}	63	50	73^{b}

Fx = fracture; Lx = luxation; IVSP = intervertebral space. Within row figures with different letters are significantly different ($p<0.05$).

Statistics

A Fisher's exact test, the Chi-squared test, or a one-way analysis of variance (ANOVA) were employed for statistical comparison of measurements between groups, depending upon the parameters evaluated and their associated factors. All of the analyses were performed using statistical software (NCSS 2007, www.ncss.com). The overall level of statistical significance was set to $p<0.05$.

Results

Forty-seven dogs, representing 23 different breeds, and 42 cats, representing eight different breeds, were included in the study. The canine group included 21 small dogs and 26 large dogs. There were significantly ($p<0.02$; Fisher's exact test) more young animals (<12 months) in the feline (19/42, 45%) than in the canine (10/47, 21%) group. Time to presentation after trauma did not significantly differ between dogs and cats, and the majority of patients were admitted within the first 24 hours (dogs: 28/46, 61%;

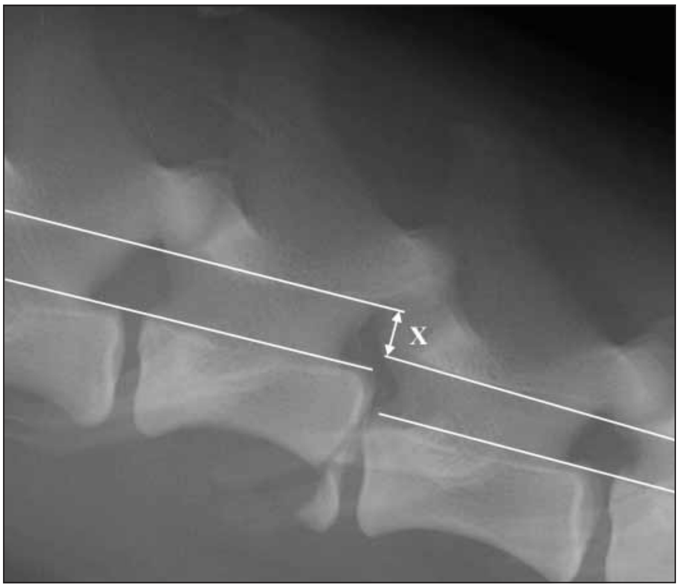

Fig. 1 Determination of the degree of dislocation. The degree of dislocation (x) ranged from 0 to 100% and was assessed by calculating the displacement of the vertebral canal between the cranial and caudal segment. The ventral margin of the vertebral canal (ventral white line) was defined as a direct line from the most dorsal point at the cranial vertebral endplate to the most dorsal point at the caudal vertebral endplate. The dorsal vertebral canal margin (dorsal white line) runs parallel to the first line, on the level of the most ventral aspect of the vertebral lamina.

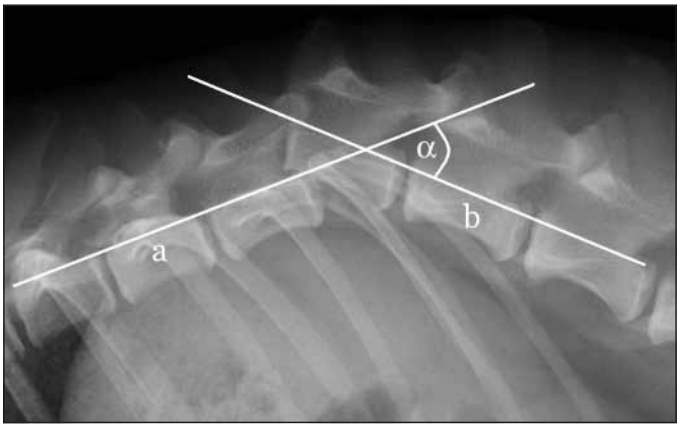

Fig. 2 Determination of axis deviation. Axis deviation was determined as the acute angle (alpha) between the long axis of the cranial (a) and the long axis of the caudal (b) segment. The long axis of each segment was calculated from the three vertebrae adjacent to the lesion. A direct line was drawn from the most ventral point of the vertebral channel, at the level of the cranial vertebral endplate of the most cranial vertebra, to the most ventral point at the level of the caudal vertebral endplate of the most caudal vertebra.

cats: 30/40, 75%). Dogs were most frequently admitted following motor vehicle trauma (25/47, 53%), whereas cats were admitted equally as often be it following a fall from a height (19/42, 45%), or following a motor vehicle trauma (17/42, 41%). Concurrent injuries were more common in cats (35/42, 83%) than in dogs (31/47, 66%), and these differences were significant ($p<0.03$; Fisher's exact test) between cats and large dogs (15/26, 58%). Small dogs (16/21, 76%) also had more concurrent injuries than large dogs, though these differences were not significant. The mode of treatment was similar for cats (conservative: 11/42, 26%; surgical stabilisation: 11/42, 26%; none: 20/42, 48%) and dogs (conservative: 11/47, 24%; surgical stabilisation: 18/47, 38%; none: 18/47, 38%). Treatment was initiated in five grade V patients (three dogs and two cats; four times conservative and once surgical stabilisation). The neurological status at the time of admission was similar between cats and dogs. A Schiff-Sherrington syndrome was noted in 20 of 47 dogs (43%, lesions between Th8/9 and L6/7), all of which had grade IV or V neurological deficits, but was not observed in any of the cats (Table 2). Micturition status was unknown in nearly half of the animals in our study and could therefore only be assessed in 24 cats and 28 dogs. Although differences were not significant, micturition dysfunction was diagnosed more often in cats (16/24, 67%) than in dogs (10/28, 36%). Orthogonal radiographical views were available in most animals (cats: 36/42, 86%; dogs: 42/47, 89%), for the remainder only one lateral radiograph was available.

Taking multiple lesions into account, of the total, there were 59 vertebral fractures and/or luxations in dogs and 49 in cats. Cervical lesions were not observed in cats, whereas sporadic high-cervical (C1-C5; 2/59, 3%) and cervico-thoracic (C6-Th2; 5/59, 9%) fractures and/or luxations were observed in the canine population. The thoracolumbar area (Th3-L3) was the most common localisation in both dogs (34/59, 58%) and cats (24/49, 49%), while the lumbar region (L4-L7) was second most common in both dogs (14/59, 24%) and cats (16/49, 33%). Sacral lesions (S1-S3) were more common in cats (9/49, 18%) than in dogs (4/59, 7%), with only small dogs (4/32, 13%) being affected (Table 1).

Luxations of the vertebral column were seen significantly ($p<0.05$; Fisher's Exact Test) more often in dogs (12/59, 20%) than in cats (3/49, 6%) and occurred more often in large dogs (8/27, 30%) than in small dogs (4/32, 13%). Combined fracture-luxations occurred significantly ($p<0.01$; Fisher's exact test) more often in cats than in dogs (32/49, 65%; dogs: 22/59, 37%). Transverse fractures were seen significantly ($p<0.02$; Fisher's exact test) more often in small dogs (10/32, 31%) than in cats (4/49, 8%) and significantly ($p<0.002$; Fisher's exact test) more often in small dogs (10/32, 31%) than in large dogs (0/27, 0%). While wedge compression fractures were seen more often in cats than in dogs (cats: 6/49, 12%; dogs: 4/59, 7%), subluxations occurred more frequently in dogs (dogs: 8/59, 14%; cats: 3/49, 6%). Hyperextension injury was rare in both groups (dogs: 3/59, 5%; cats: 2/49, 4%) and hyperflexion injuries were not observed at all (Table 1).

A displacement of the caudal segment was observed in most cases (cats: 37/49,

Table 2 Clinical data and outcome for 42 cats and 47 dogs with vertebral fractures and luxations. Due to low patient numbers animals with neurological grades I-III (see text for definition) were pooled. Data regarding outcome was calculated from 39 cats and 46 dogs.

		Cats %	Dogs %		
			Total	Small dogs	Large dogs
		n = 42	n = 47	n = 21	n = 26
Age < 1 year		45[a]	21[b]	29	15[b]
Time to presentation	< 24h	76	61	57	64
	> 24h	24	39	43	36
Aetiology	HBC	41	53	48	58
	Fall	45	21	14	27
	Others	14	26	38	15
Concurrent injuries		83[a]	66	76	58[b]
Neurological status	I-III	36	45	48	42
	IV	21	19	14	23
	V	43	36	38	35
Schiff-Sherrington Syndrome		0[a]	43[b]	38[b]	46[b]
Treatment	Conservative	26	24	33	16
	Surgical	26	38	33	42
	None	48	38	33	42
		n = 39	n = 46	n = 20	n = 26
Outcome	Excellent	26	24	35	15
	Functional	13	20	15	23
	Poor	61	56	50	62

HBC = hit by car. Within row figures with different letters are significantly different (p<0.05).

76%; dogs: 38/59, 64%). A dorsal displacement occurred more often in cats (24/37, 65%) than in dogs (14/38, 37%), while ventral displacement was more common in dogs than in cats (dogs: 24/38, 63%; cats: 13/37, 35%), and was particularly frequent in large breeds (16/22, 73%). These differences were significant (p<0.01; Fisher's exact test) between large dogs and cats. Dorsal compartment involvement alone (small dogs: 10/32, 31%; large dogs: 0/27, 0%) as well as the occurrence of multiple vertebral fractures and/or luxations (small dogs: 9/32, 29%; large dogs: 1/27 4%) were observed significantly (p<0.002 for dorsal compartment involvement; p<0.04 for occurrence of multiple vertebral fractures and/or luxations; Fisher's Exact Test) more often in small than in large dogs. Furthermore, the intervertebral disc space was significantly (p<0.005 for large and small dogs; p<0.01 for large dogs and cats; Fisher's Exact Test) more frequently affected in large dogs (23/27, 85%) than in small dogs (15/32, 47%) or cats (26/49, 53%). End plate-physeal fractures (cats: 8/49, 16%; dogs: 6/59, 10%) occurred only in animals younger than one year and were seen less often than endplate-fractures (cats: 18/49, 37%; dogs: 13/59, 22%). Degree of dislocation (cats: 40% [20–7]; dogs: 40% [20–60]; median with 95% confidence interval) and axis deviation (cats: 11° [6–16]; dogs: 12° [7–17]; median with 95% confidence interval) did not differ significantly between the feline and canine population. This was also true for caudal segment-rotation (Table 1).

The mean follow-up time for all of the animals was 17 months (range: one to 74 months). Follow-up was available in 20/21 dogs and 15/18 cats that were initially discharged from the hospital. Outcome could therefore be assessed in 39 cats and 46 dogs and did not differ significantly among species. In cats it was 'excellent' in 10 (10/39, 26%), 'functional' in five (5/39, 13%) and 'poor' in twenty-four (24/39, 61%) cases. In the canine population outcome was 'excellent' in eleven (11/46, 24%), 'functional' in nine (9/46, 20%) and 'poor' in twenty-six animals (26/46, 56%) (Table 2). In all grade 5 cases (three dogs and two cats) in which treatment was initiated outcome was always poor and led to euthanasia at a later point. Due to the relatively small number of cases and statistical tests applied, most parameters were not significantly associated with outcome. One exception was the degree of dislocation, which was significantly associated (p<0.001; Kruskal-Wallis one-way ANOVA) with a worse outcome in dogs. Though a comparable pattern was observed in our feline population, significance failed to be established (Fig. 3). A further exception was axis deviation, which was significantly associ-

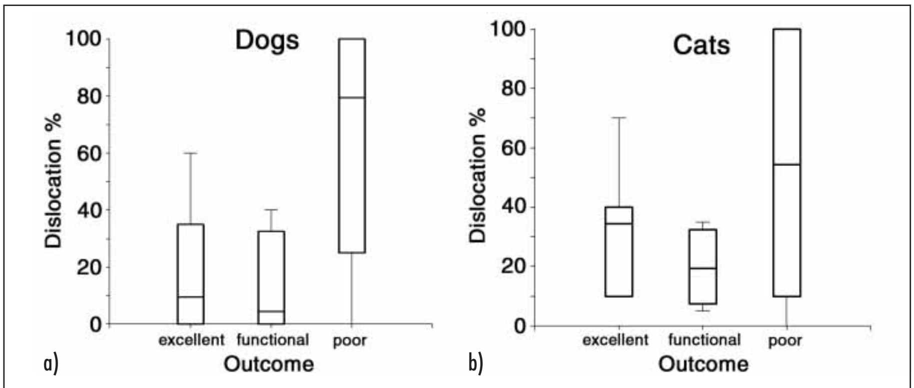

Fig. 3 Association of the degree of dislocation with outcome in 42 cats and 47 dogs. The degree of dislocation was significantly (p<0.001) associated with a worse outcome in dogs (a). Though a comparable pattern was observed in our feline population, significance failed to be established (b). The box represents the 25%ile, median and 75%ile values. The whiskers approximate the central 95% of the data range.

ated with a worse outcome in dogs (p<0.005; Kruskal-Wallis one-way ANOVA) but not in cats (Fig. 4).

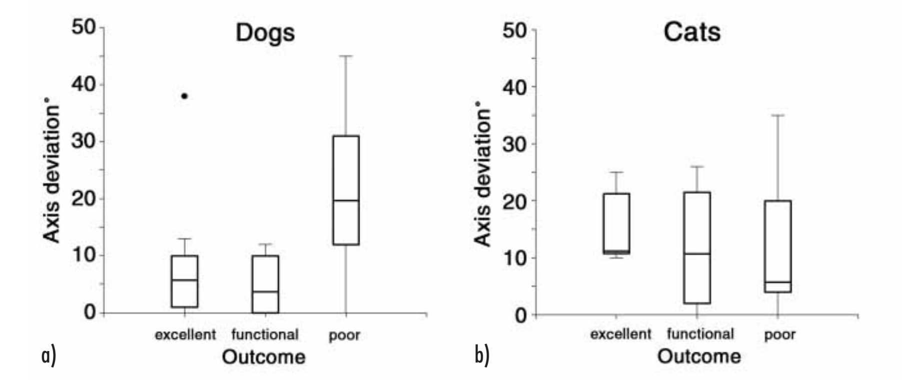

Fig. 4 Association of the axis deviation with outcome in 42 cats and 47 dogs. The degree of axis deviation was significantly ($p < 0.005$) associated with a worse outcome in dogs (a) but not in cats (b). The box represents the 25%ile, median and 75%ile values. The whiskers approximate the central 95% of the data range. Outliers are represented as dots.

Discussion

In our study population, there were significantly more young animals (<12 months) in the feline (45%) than in the canine (21%) group. Similar results with 39% of the cats less than one year of age were reported in another study (4). Inexperience and curiosity in the first months of roaming outdoors were probably responsible for the higher number of young cats involved.

Concurrent injuries were significantly more common in cats (83%) than in large dogs (58%). A similar trend was observed in small canine breeds (76%). A previous study on spinal trauma in cats (4) reported far less concurrent injuries (30%). However, only 25% of the animals in this study had neurological deficits grade IV or V compared to 64% in our feline population, which suggests a higher severity of trauma in our feline population than in the previously published study. A possible reason for more frequent concurrent injuries in cats is that impact trauma more likely creates multiple trauma when body size is small. Unfortunately we did not find any studies that compared traumatized cats and dogs to back up our hypothesis.

The Schiff-Sherrington syndrome refers to the phenomenon of thoracic limb extensor hypertonicity associated with paraplegia from acute thoracolumbar spinal cord lesions. The so-called border cells (spinal cord segments L1 to L7) are largely responsible for the tonic inhibition of extensor muscle alpha motoneurons in the cervical intumescence. The thoracic limb hypertonicity usually subsides after 10 to 14 days (12). A Schiff-Sherrington syndrome is generally considered to be associated with severe spinal injuries (1). Findings in our study corroborate this notion as we only observed it in grade IV or V canine patients. Although Schiff-Sherrington syndrome was associated with a worse outcome, significance could not be demonstrated due to low patient numbers.

We did not observe a Schiff-Sherrington syndrome in our feline population. That-syndrome has been previously induced experimentally in cats (13), by transecting the spinal cord. However, those cats were also decerebrated, causing decerebrate rigidity. In these experiments, the brainstem was transected between the colliculi of the midbrain, which produces an uninhibited extensor tonus with rigid extension of all four limbs. Since these cats also suffered a severance of the thoracic or thoracolumbar spinal cord, the rigidity was only seen in the forelimbs and may have only mimicked true Schiff-Sherrington syndrome. In previously published clinical reports involving either cats (4, 5) or mixed populations (6, 7), Schiff-Sherrington was not suggested by the neurological examination findings in any cat with grade IV or V neurological deficits, corroborating our finding. One can only speculate whether this may be due to the influence of upper neuronal centres or a faster adaptation of feline inter- or motoneurons compared to those of the canine cervical intumescence.

Micturition dysfunction occurred more often in cats (67%) than in dogs (36%) although this difference was not statistically significant. Previous studies revealed similar results with 60% to 76% of cats (5, 6) and 30% of dogs (6).

Vertebral fractures and/or luxations generally occur at the junction between stable and more mobile parts of the vertebral column, close to the skull, thorax and pelvis. The terminal thoracic region is the most frequently affected site in the dog (14). Our study revealed similar results with most of the canine (58%) and feline (49%) lesions located in the thoracolumbar area. Other studies that looked into lesions from C1-L7 found 50% thoracolumbar lesions in dogs (6) and 60% to 83% in cats (5, 6). One further study (8) found the lumbar area (L1-L7) to be the most common location in dogs (39%) and the sacrocaudal region (S1-Cc3) in cats (46%). This may be explained by the different grouping of lesion locations and the inclusion of caudal vertebrae.

None of our feline vertebral fractures and/or luxations occurred in the cervical area. Other studies also did not report any cervical lesions in populations of 26 (8) and 30 (5) cats, and only two cervical lesions in a further study of 69 cats (4). Possible explanations might be differences in aetiology and body size, given that dogs are mostly affected by motor vehicle accidents and cats are equally prone to falls from heights. The 12% cervical fractures and/or luxations (C1-Th2) that occurred in our canine population are consistent with the 7% to 20% described in the literature (7, 8). In one study of cervical fractures in 56 dogs (15), 60% of the population consisted of large dogs, weighing over 15 kg. We found no such difference in our population, although our numbers were too small to bear significance.

Sacral fractures are occasionally seen in dogs with 2% to 23% described in the literature (6, 8). Similar numbers have been noted in cats (4). In our study, sacral fractures accounted for 7% in dogs, occurring only in small dogs (13%), and for 18% in cats. Possible explanations for the higher incidence among cats and small dogs may lie in their anatomy, with thinner vertebral bone and lesser soft tissue protection, as well as differences in trauma aetiology.

We found significantly more luxations of the vertebral column in the canine (20%) than in the feline (6%) group. Other studies have found 10% to 19% luxations in feline populations (4, 5), although in the latter study, luxations were probably pooled together with subluxations, which may have lead to this higher number. Another study looked at a mixed population of dogs and cats without differentiating between them (8) and found 20% luxations. We also found that large dogs (30%) seem to be more prone to luxations than small dogs (13%). A possible explanation for the lower incidence of luxations in cats and small dogs compared to large dogs may again be due to anatomical differences. The vertebrae of cats and small dogs are far more delicate and may therefore be more prone to additional fracture than the bulkier vertebrae of larger dogs.

Combined fracture-luxations were seen significantly more often in cats (65%; dogs: 37%). A possible explanation is again the comparably thin vertebral bone, which may render it more susceptible to additional fracture. Another study looking exclusively at cats found only 30% fracture-luxations (4). The animals in this study had a far lower ratio of concurrent injuries (30%) compared to our cats (83%), and only contained 25% animals with neurological grade IV or V compared to 64% in our feline population. This implies that these animals may have been involved in comparably less severe accidents resulting in less complicated fractures. We did not find a previous canine study that distinguished fracture types in a similar manner.

We observed differences in the direction of caudal segment displacement. In cats the caudal segment tended to displace dorsally (65%), which differed significantly from our population of large dogs that mostly showed ventral displacement (73%). This may again be explained with differences in anatomy, trauma aetiology and forces conveyed. Because of the shape of the dorsal facet joints, a dorsal displacement of the caudal segment seems almost impossible without fracturing parts of these joints. Due to the delicate nature of their vertebrae, cats may be more prone to additional fracturing of their articular processes and dorsal displacement seems to be more likely than in large dogs where these processes are much stronger.

End plate involvement has only rarely been addressed in the previous reports. One feline study (5) found end plate involvement in 43% of their cases. This is in agreement with the 53% among our cats. Another canine and feline study (8) found 4% end plate fractures and 5% endplate-physeal fractures, but failed to link these with species or age. We noted far more end plate fractures (cats: 37%; dogs: 22%) as well as end plate physeal fractures (cats: 16%; dogs: 10%) in our population. All of our animals with end plate physeal fractures were younger than one year. According to the literature, canine vertebral epiphyseal closure is complete after 11–14 months (16). A similar timeframe can be expected in cats. Hence, true end platephyseal fractures are unlikely to be encountered in mature animals.

The outcome did not differ significantly between our populations of cats (excellent: 26%; functional: 13%; poor: 61%) and dogs (‘excellent’: 24%; ‘functional’: 20%; ‘poor’: 56%) (Table 2) and was slightly worse as previously reported in the literature. Several studies described outcome in cats as ‘excellent’ in 33%-36%, ‘functional’ in 9%-22% and ‘poor’ in 44%-55% (5, 6). One study reported outcome among dogs as ‘excellent’ in 48%, ‘functional’ in 13% and ‘poor’ in 39% (6). Possible explanations for the presumably worse outcome in our study could be differences in aetiology, population composition and pretreatment decision making based on perceived prognosis compared to other studies.

The degree of dislocation and axis deviation were both significantly associated with a worse outcome in dogs but not in cats. To the authors’ knowledge, there have not been any veterinary studies that have investigated these findings. A possible explanation may be the higher incidence of additional dorsal compartment fractures in cats. These may reduce the dorsal compartment impact on spinal cord compression in cases of dislocation. Nevertheless, these findings need to be interpreted with caution as the radiographic displacement does not necessarily relate to the degree of displacement at the moment of impact and therefore does not necessarily correlate with the degree of spinal cord trauma.

Unfortunately, a number of our cases had only one lateral radiograph. As a result, the degree of dislocation and axis deviation may have been underestimated in those cases with displacement in the second plane. Nevertheless, it remains unclear how important these shortcomings really are as the actual displacement at the time of trauma cannot be known. In the animals that had orthogonal views taken (cats: 86%; dogs: 89%), displacement was always best seen in the lateral views. Therefore, it is likely that the absence of ventrodorsal views in some cases did not have a significant influence on the differences between dogs and cats regarding degree of dislocation and axis deviation.

Further shortcomings of our study were clearly its retrospective nature and the limited patient numbers. Goals for future investigations will be to perform prospective work and to integrate more advanced diagnostic imaging techniques, such as magnetic resonance imaging.

In conclusion, the neurological status at the time of presentation, overall outcome and localisation of the lesion appear to be similar between cats and dogs with vertebral fractures and/or luxations. Cats do not seem to exhibit a Schiff-Sherrington syndrome as do most dogs with neurological grade IV or V lesions. Other differences exist in the fracture type. Cats and small dogs may be more prone to additional fractures than large dogs. Nevertheless, most of the differences between the two species do not seem to have any influence on outcome. Exceptions are the degree of dislocation and axis deviation, which were associated with a worse outcome in dogs but not in cats.

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