

Calcification of Intervertebral Discs in the Dachshund: A Radiographic Study of 115 Dogs at 1 and 5 Years of Age

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Stigen, Ø.: Calcification of intervertebral discs in the dachshund. A radiographic study of 115 dogs at 1 and 5 years of age. Acta vet. scand. 1996, 37, 229-237 – The vertebral columns of 115 dachshunds were x-rayed at 1 and 5 years of age. This sample represented 5.7% of all dachshunds registered with the Norwegian Kennel Club in the period 1986-1988. All dogs were clinically normal at the commencement of the study. At 1 year of age calcified intervertebral discs were identified in 34 (29.6%) of the dogs and the number of calcified discs in each individual varied from 1 to 7 with a mean of 2.7. At 5 years of age calcified discs were identified in 66 (57.4%) of the dogs and the number of calcified discs in each individual varied from 1 to 11 with a mean of 3.2. Of all dogs in which calcified discs were identified at 1 year of age, 33 (97.1%) were found to have calcified discs also at 5 years of age.

Of 92 calcified discs identified in the dogs at 1 year of age, 29 (31.5%) were not calcified 4 years later. Of 211 calcified discs identified in the dogs at 5 years of age, 148 (70.1%) were not calcified 4 years before.

From 1 to 5 years of age, signs of spinal disease were registered in 12 (35.3%) of the dogs in which calcified discs were identified at 1 year of age, and in 7 (8.6%) of the dogs in which calcified discs were not identified at 1 year of age. Of all dogs in which one or more calcified discs had disappeared during the study-period, signs of spinal disease were registered in 9 (75.0%).

vertebral column; degeneration.

Introduction

In veterinary medicine intervertebral disc disease (IDD), which predominantly involves disc protrusions, is almost exclusively diagnosed in the dog. The disease occurs in all breeds of dogs, but is most frequently seen in the dachshund (Oliver *et al.* 1987). The occurrence of IDD in the dachshund has been estimated to be 19.0% (Ball *et al.* 1982).

A dystrophic calcification of the nucleus pulposus is an important factor in the pathogenesis of IDD in the dachshund (Hansen 1952, Hansen 1966). In a radiographic study Havranek-Balzaretti (1980) found that 49 (79.0%) of 62 adult dachshunds that had calcified discs developed

IDD whereas 38 adult dogs without calcified discs did not develop the disease.

Although calcification of the nucleus pulposus is known to be initiated by a chondroid metamorphosis of mesenchymal cells (Hansen 1952), the etiology of calcified discs in the dachshunds is not completely understood. However, a genetic factor is essential for the occurrence of calcified discs in a dog while a common environmental factor presumably resulting from non-genetic causes is significant in determining the number of discs to undergo calcification in an affected dog (Stigen & Christensen 1993).

Using 2 different methods *Stigen & Christensen* (1993) estimated the heritability of calcified discs in the dachshund to be 0.15 and 0.22. Thus, the potential exists for a breeding programme that could reduce the occurrence of calcified discs and thereby IDD in this breed. The recommendation would be that dachshunds from families with many members affected by calcified discs should not be used for breeding. A radiographic examination of the vertebral column is the most practical method for the identification of calcified discs in live dachshunds. If such an examination is to be included as part of a breeding programme, then it should be performed before the animal is used for breeding. On the other hand, the radiographic examination should not be carried out before those intervertebral discs which will undergo calcification, can be identified as such. Thus, the age beyond which dachshunds usually do not develop any more calcified discs, is of interest.

In a radiographic study, *Havranek-Balzaretti* (1980) found that none of 11 one-year-old dachshunds developed more calcified discs up to 4 years after examination. However, in a later study, *Stigen* (1995) compared the frequency of calcified discs in young (mean age = 1.2 years) versus adult (mean age = 8.0 years) dachshunds and found strong indications that calcification of intervertebral discs continued to occur after 1 year of age. Thus, the occurrence of calcification of intervertebral discs beyond 1 year of age is uncertain.

This paper presents the findings from a radiographic study of calcified intervertebral discs in dachshunds examined at 12 to 18 months and 5 to 6 years of age. The number of calcified discs and their distribution within the vertebral column are compared at the 2 ages. Any history of spinal disease is related to the occurrence of calcified discs in the dog concerned. The reliability of a radiographic examination at 1 year

of age as a prediction of the subsequent occurrence of spinal disease is evaluated and its potential as an aid in the selection of breeding animals is discussed.

Materials and methods

A radiographic study of the occurrence of calcified intervertebral discs in young dachshunds was conducted at Department of Small Animal Clinical Sciences, Norwegian College of Veterinary Medicine in the period 1987-1989 (*Stigen* 1991). The 327 dogs included in that study were 12 to 18 months old.

The owners of these dogs were asked to present their animals for a second physical and radiographic examination. This time the examination was limited to dachshunds 5 to 6 years of age and was conducted in the period 1991-1993. The dogs were divided into size and coat varieties and radiographs were taken and read according to the methods used in the previous study of young dogs (*Stigen* 1991).

Radiographs were taken of the vertebral columns of 115 dachshunds which represented 35.2% of the dogs that were examined in 1987-1989 and 5.7% of all dachshunds registered with the Norwegian Kennel Club in the period 1986-1988. There were 61 (53.0%) females included in the study and the distribution of size and coat varieties is presented in Table 1. The study population had a similar sex and size and coat distribution to that of the dachshunds included in the previous study (*Stigen* 1991).

For the present paper radiographs both from the first (1987-1989) and the second (1991-1993) examinations are included for the 115 dachshunds. At the first examination the ages of these dogs ranged from 365 to 542 days with a mean of 418 days (SD = 35.5 days) whereas at the second examination their ages ranged from 1837 to 2177 days with a mean of 2006 days (SD = 83.5 days).

Table 1. The distribution of 115 dachshunds by size and coat varieties.

Coat	Size			Total
	Standard	Dwarf	Kaninchen	
Smoothcoated	21 (18.3)*	0 (0)	0 (0)	21 (18.3)
Wirecoated	27 (23.5)	2 (1.7)	0 (0)	29 (25.2)
Longhaired	31 (26.9)	33 (28.7)	1 (0.9)	65 (56.5)
Total	79 (68.7)	35 (30.4)	1 (0.9)	115 (100.0)

* Percent.

Based on the reported history and the physical examination, the dogs with signs of spinal disease were divided into 2 groups. In the first group were dogs that had shown or were showing neck and back pain, weakness and/or ataxia. In the second group were dogs that had shown or were showing an inability to support weight on their limbs. The signs in the first group were classified as degree 1 and in the second group as degree 2.

Statistical analysis was performed to test for differences in the proportion of dogs with calci-

fied discs at 1 versus 5 years of age. As the same dogs were examined at both ages, a McNemar's chi-square test was used.

Results

At the first examination (Fig. 1), calcified discs were identified in 34 (29.6%) of the dachshunds and at the second examination (Fig. 2) in 66 (57.4%). The difference between the results of the 2 examinations was found to be significant ($p < 0.001$). With the exception of one dog, all dachshunds with calcified discs at the first ex-

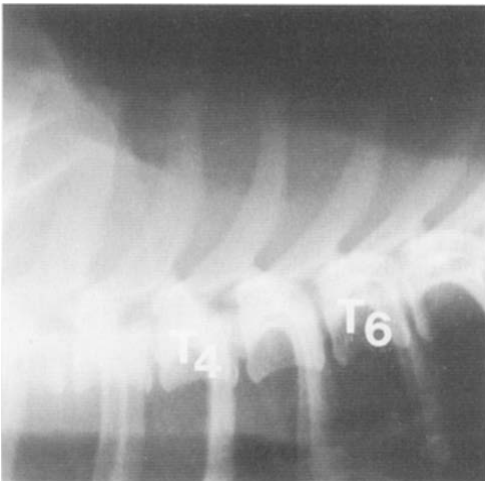


Figure 1. Longhaired dachshund of standard size, 1 year and 9 days old, without calcified intervertebral discs in the cranial part of the thoracic vertebral column.

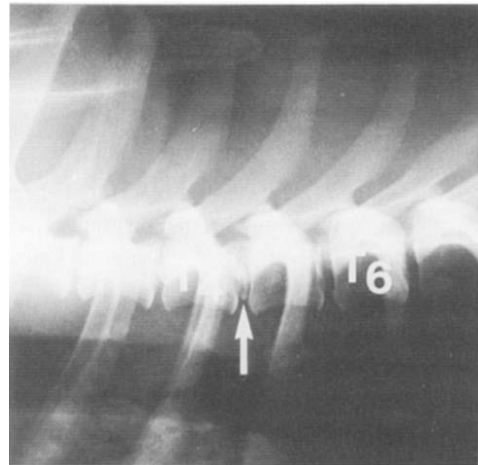


Figure 2. Same dog as shown in Fig. 1, 5 years and 45 days old, with 1 calcified intervertebral disc in the cranial part of the thoracic vertebral column (arrow).

Table 2. The distribution of 115 dachshunds with the presence (+) or absence (-) of calcified discs at young (1st examination) and adult (2nd examination) age. The number of dogs in which clinical signs of spinal disease were or were not registered is shown. The prevalence of spinal disease in these dogs is also given.

Presence of calcified discs		Signs of spinal disease		
1st examination	2nd examination	Registered (a)	Not registered (b)	Prevalence (a/a+b x 100%)
-	-	3	45	6.3
-	+	4	29	12.1
+	-	0	1	0.0
+	+	12	21	36.4
Total		19	96	16.5

amination also had calcified discs at the second. A total of 92 calcified discs were found at the first examination. The number of calcified discs in each affected dog ranged from 1 to 7 with a mean of 2.7 (SD = 1.9).

A total of 211 calcified discs were found at the second examination. The number of calcified discs in each affected dog ranged from 1 to 11 (Fig. 3) with a mean of 3.2 (SD = 2.4). At the second examination, the mean number of calcified discs in affected dogs was 4.3 in those that had calcified discs at the first examination, and 2.1 in those that did not have calcified discs at the first examination.

At the second examination, calcification was identified in each cervical, thoracic and lumbar intervertebral disc and the distribution of affected discs throughout the vertebral column had a pattern that was similar to the distribution in the first examination (Fig. 4). The cumulative distribution of affected discs identified three sections (C3-T1, T2-3 and T10-13) of the vertebral column that had 10 or more calcified discs per intervertebral space.

Of the 211 calcified discs identified in the dogs at 5 to 6 years of age, 148 (70.1%) were not calcified 4 years before. In 12 dogs, 29 intervertebral discs that were identified as calcified at the first examination, were not calcified at the second examination. Of these discs, 17 (58.6%)

were localized to the T1-9 section of the vertebral column.

At the second examination, one dachshund had clinical signs of spinal disease and 18 dogs were reported to have previously shown signs of spinal disease. The distribution of dogs based on signs of spinal disease and the presence of calcified discs is presented in Table 2. The proportion of dachshunds with signs of spinal disease was 23.9% in dogs with calcified discs at the first and/or second examination and 6.3% in dogs without calcified discs.

Of dogs with calcified discs at the first examination, 35.3% (12/34) showed signs of spinal disease. In comparison, 8.6% (7/81) of dogs that did not have calcified discs at the first examination, showed signs of spinal disease. Thus, the proportion of dogs with signs of spinal disease was 4.1 times higher among dogs with calcified discs at the first examination compared with dogs that did not have calcified discs at the first examination.

Spinal disease was registered in nine (75.0%) of the 12 dogs in which one or more calcified discs disappeared between the 2 examinations. In dogs with calcified discs that did not disappear, spinal disease was registered in 3 (13.6%).

Of all dogs with spinal disease, 15 had degree 1 signs and four had degree 2 signs. The latter group consisted of dogs that had calcified discs

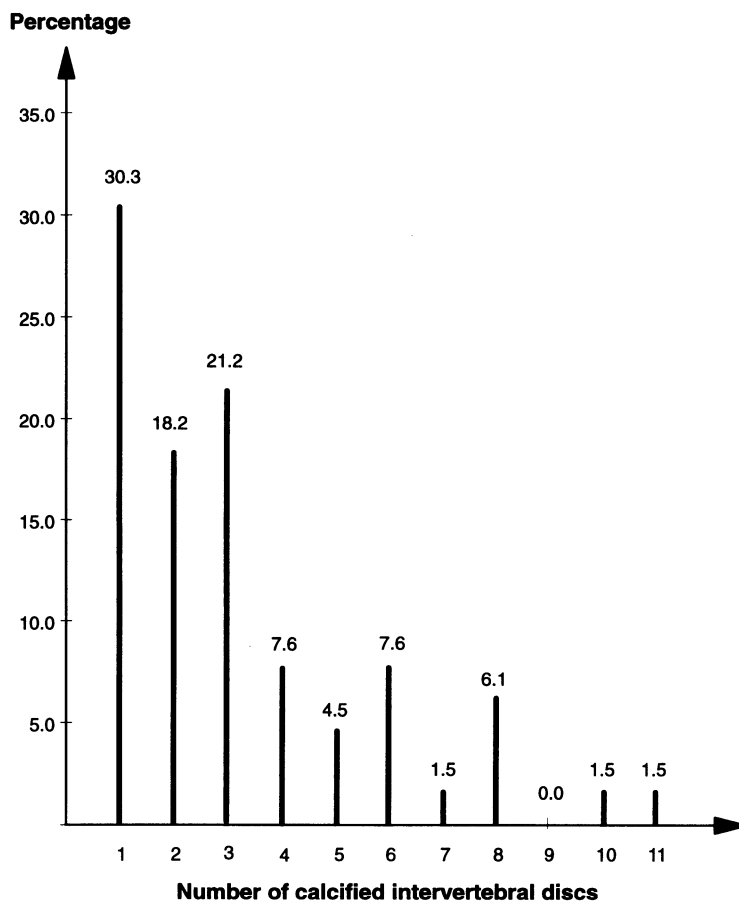


Figure 3. Sixty-six dachshunds distributed (percentage) by number of calcified intervertebral discs. The dogs are all 5 years old.

both at the first and at the second examination.

Discussion

In the present study, the number of dogs with calcified discs and the mean number of calcified discs in affected dogs were both found to be higher at the second than at the first examination. Thus, these results show that calcification of intervertebral discs occurs in dachshunds be-

yond 12 months of age. These findings are consistent with previous studies that have shown a higher occurrence of calcified discs in adult dachshunds (42.9%) (Stigen 1995) than in young dogs (24.2%) (Stigen 1991). However, in a study of 45 dachshunds of various ages, *Havranek-Balzaretti* (1980) found that intervertebral discs which had not begun to calcify by 12 months of age did not calcify subsequently. The small number of young dogs followed-up in that study, may have obscured the effect of age

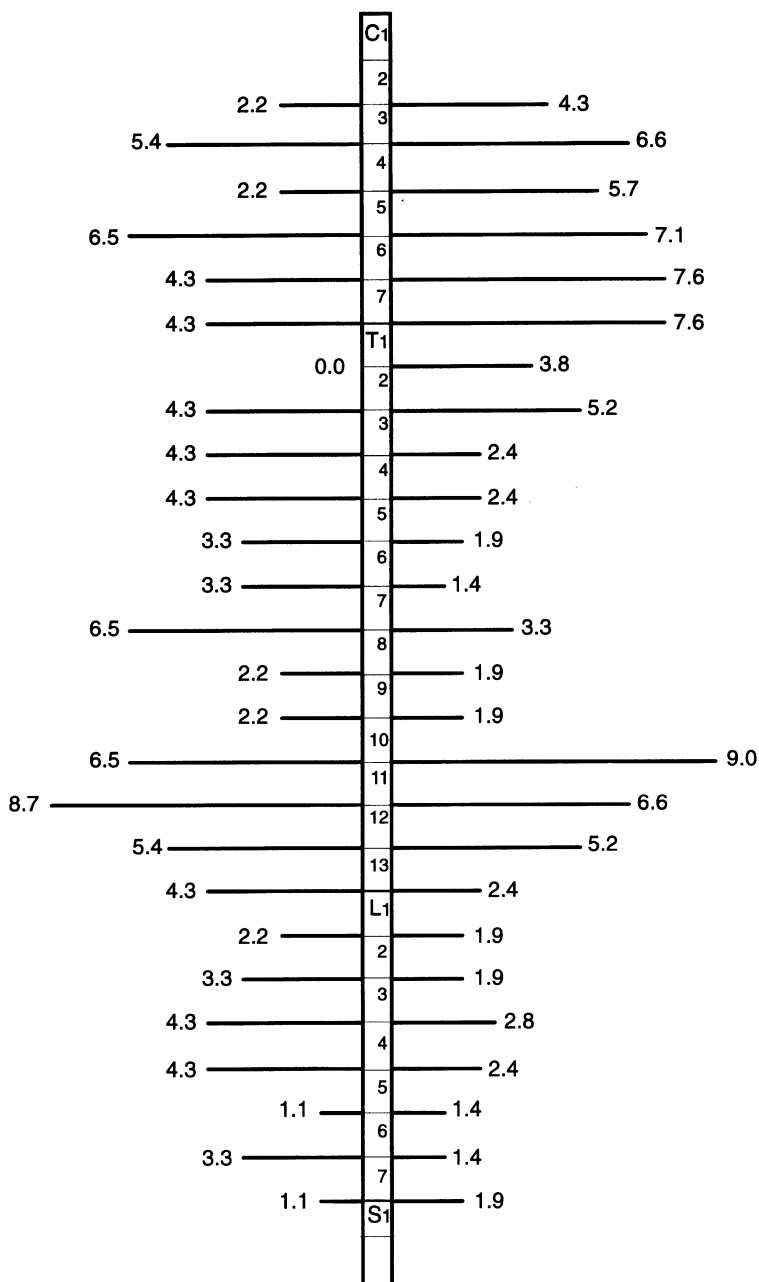


Figure 4. The percentage distribution, throughout the vertebral column, of 92 calcified intervertebral discs in 34 affected, 12 to 18 months old dachshunds (left) and 211 calcified intervertebral discs in 66 affected, 5 to 6 year old dachshunds (right). The atlanto-axial joint (C1-2) does not contain an intervertebral disc.

on calcification of discs that was identified in the present study

In dachshunds, IDD is most often seen in middle-aged dogs and 45.3-55.7% of all cases are found in dogs aged between 4 and 7 years (Oliver *et al.* 1987, Goggin *et al.* 1970). In a study of 3,898 dachshunds with IDD, Priester (1976) found that the disease occurred most frequently in 5 year old dogs. As the occurrence of IDD and the presence of calcified discs have been shown to be positively correlated (Hansen 1952, Havranek-Balzaretti 1980), the second examination for calcified discs in the present study was performed on dachshunds at 5 to 6 years of age.

The occurrence of calcified discs in the study population of 12 to 18 months old dachshunds (29.6%) was similar to the overall occurrence of calcified discs in the population of young dachshunds that were examined in 1987-1989 (24.2%) (Stigen 1991). The distribution of dogs into sex and size and coat varieties was also similar in these 2 populations. The dachshunds included in the present study have therefore been exposed to insignificant selection errors and consequently are assumed to be representative of the population of dachshunds previously examined by Stigen (1991).

The percentage of dachshunds with calcified discs identified at the second, but not at the first examination was large (28.7%). Thus, the absence of calcified discs in radiographs of dachshunds aged between 12 and 18 months does not guarantee that the discs will be uncalcified in the future. This finding must be considered in any eradication programme for IDD based on radiographs. A practical recommendation could be that young dachshunds without calcified discs should only be used for restricted breeding. If the animal is to be used for more than 1-2 litters, then a re-examination should be performed and the animal's family (parents, siblings, offspring) should also be examined.

Only dachshunds without calcified discs at adult age and from families with many members not affected by calcified discs, should continue to be used for breeding.

The percentage of dachshunds with calcified discs identified at the first, but not at the second examination was low (0.9%). Thus, a radiographic examination of 5-year-old dachshunds will reveal rather all dogs having calcified discs also at 1 year of age. The conclusion must be that selection of breeding animals should be based on results from a radiographic examination performed as close to an intended mating as possible.

At the second examination, the entire cervical and the caudal part of the thoracic vertebral column were found to have the highest occurrence of calcified discs. Hoerlein (1978) found that 69.3% of 2,620 canine disc lesions occurred in the C2-T1 and T10-L1 sections of the vertebral column. The results of this large study and the present study support the existence of a positive correlation between the occurrence of calcified discs and disc lesions at different locations of the vertebral column. However, the presence of calcified discs is not the only significant factor in the development of IDD in dogs. Hansen (1966) described the contribution of both anatomical and mechanical factors. The presence of *ligamentum intercapitale* in the T1-10 section and the ability of this ligament to prevent dorsal disc protrusions, is considered a significant anatomical factor (Hansen 1952, King 1956). A significant mechanical factor is the sagittal movement of the vertebral column in running dogs, which produces great mechanical stress just caudal to T11 (Verheijen & Bouw 1982).

Previous signs of spinal disease were evaluated by the owners and the registration of these signs therefore involves a degree of subjectivity. Since pain, weakness and deficit of voluntary movement may be caused by diseases such as

spondylosis deformans, discospondylitis, vertebral fractures and spinal cord tumors, the signs registered were not specific and thereby do not constitute a diagnosis of IDD. The actual number of dogs with IDD is therefore expected to be somewhat lower than the recorded number with spinal disease. On the other hand, dachshunds may be euthanized because of serious IDD before 5 years of age (*Funkquist 1962 a, b*) or may develop the first signs of IDD after 5 years of age (*Priester 1976*). In both of these cases, the percentage of dachshunds developing IDD will be found to be too low if estimated solely on results from a study of 5 years old dogs. Thus, the percentage of dogs with signs of spinal disease registered in the present study (16.5%) cannot be compared with the occurrence of IDD in the dachshund (19.0%) previously estimated by *Ball et al. (1982)*.

The percentage of dachshunds with signs of spinal disease was larger in dogs with calcified discs at the first and/or second examination (23.9%) than in dogs without calcified discs (6.3%). This finding is in agreement with previous studies that have shown that the occurrence of spinal disease in chondrodystrophoid dogs is associated with presence of calcified discs (*Hansen 1952, Hoerlein 1953*). However, the association identified in the present study is not as marked as the association found by *Havranek-Balzaretti (1980)* in a study of 100 dachshunds aged between one and 15 years. In that study, spinal disease was identified in 79.0% of the dogs with calcified discs, but in none without calcified discs.

It should be emphasized that information obtained by reading radiographs is valid only for when the radiographic examination was performed. Thus, in the present study calcified discs may have appeared and subsequently disappeared in the period between the 2 radiographic examinations. Protrusion of disc material which became calcified after the first

examination may well explain the signs that were registered in the 3 dogs in which calcified discs were not identified. In the same way, the signs of spinal disease that were registered in dogs that had the same number and location of calcified discs at both examinations, may be explained by the protrusion of calcified discs which developed between the 2 examinations.

Spinal disease was not registered in 3 of the 12 dogs in which calcified discs were found to disappear. This observation demonstrates that calcified discs can disappear without producing clinical disease. This observation has previously been reported by *Havranek-Balzaretti (1980)* who in a study of 43 dachshunds found calcification to disappear without causing any signs of spinal disease in 4 dogs. In the present study more than half of the intervertebral discs which were calcified at the first, but not at the second examination, were located to the T1-9 section of the vertebral column. In this section, dorsal disc protrusions (*Hansen 1952*) and canine disc lesions of clinical significance (*Hoerlein 1978*) have not previously been identified. Thus, the disappearance of calcified disc material in the T1-9 section cannot be explained. However, protrusions in other than a dorsal direction could be suspected.

In all dogs with signs of spinal disease, only 4 (21.1%) were classified as degree 2. As dogs with serious signs of spinal disease could be euthanized and thereby not presented for the second examination, the proper percentage of such cases is likely to be higher. Previous reports of the percentage distribution of dogs with different clinical signs of IDD were not found.

References

- Ball MU, McGuire JA, Swaim SF, Hoerlein BF*: Patterns of occurrence of disk disease among regis-

- tered dachshunds. *J. Amer. vet. med. Assoc.* 1982, *180*, 519-522.
- Funkquist B*: Thoraco-lumbar disc protrusion with severe cord compression in the dog. II. Clinical observations with special reference to the prognosis in conservative treatment. *Acta vet. scand.* 1962a, *3*, 317-343.
- Funkquist B*: Thoraco-lumbar disc protrusion with severe cord compression in the dog. III. Treatment by decompressive laminectomy. *Acta vet. scand.* 1962b, *3*, 344-366.
- Goggin JE, Li A, Franti CE*: Canine intervertebral disk disease: characterization by age, sex, breed and anatomic site of involvement. *Amer. J. vet. Res.* 1970, *31*, 1687-1692.
- Hansen HJ*: A pathologic-anatomical study on disc degeneration in dog. *Acta orthop. scand.* 1952, *suppl. 11*, 1-117.
- Hansen HJ*: Pathogenesis of disc degeneration and rupture. In: *Pettit GD (ed.): Intervertebral disc protrusion in the dog.* Appleton-Century-Crofts, New York 1966, 21-50.
- Havranek-Balzaretti B*: Beitrag zur Aetiologie der Dackellähme und Vorschlag zur züchterischen Selektion. (The etiology of intervertebral disc disease in the dachshund and proposal of an eradication programme). Zürich: Veterinär-Chirurgischen Klinik und Institut für Veterinärpatologie, 1980. Dissertation, Universität Zürich.
- Hoerlein BF*: Intervertebral disc protrusions in the dog. I. Incidence and pathological lesions. *Amer. J. vet. Res.* 1953, *14*, 260-274.
- Hoerlein BF*: Canine neurology. Diagnosis and treatment. Philadelphia: W.B. Saunders 1978, 470-550.
- King AS*: The anatomy of disc protrusion in the dog. *Vet. Rec.* 1956, *68*, 939-951.
- Oliver JE, Hoerlein BF, Meyhew IG*: Veterinary neurology. Philadelphia: W. B. Saunders 1987, 321-341.
- Priester WA*: Canine intervertebral disc disease – occurrence by age, breed and sex among 8,117 cases. *Theriogenology* 1976, *6*, 293-303.
- Stigen Ø*: Calcification of intervertebral discs in the dachshund. A radiographic study of 327 young dogs. *Acta vet. scand.* 1991, *32*, 197-203.
- Stigen Ø*: Calcification of intervertebral discs in the dachshund. A radiographic study of 21 stud-dogs. *Acta vet. scand.* 1995, *36*, 329-334.
- Stigen Ø, Christensen K*: Calcification of intervertebral discs in the dachshund. An estimation of heritability. *Acta vet. scand.* 1993, *34*, 357-361.
- Verheijen J, Bouw J*: Canine intervertebral disc disease: A review of etiologic and predisposing factors. *Vet. Quart.* 1982, *4*, 125-134.

Sammendrag

Forkalkede intervertebralskiver hos dachshund.

En røntgenologisk undersøkelse av 115 hunder ved 1 og 5 års alder.

Virvelsøylen til 115 dachshunder ble undersøkt røntgenologisk ved 1 og 5 års alder. Hundene utgjorde 5,7% av samtlige dachshunder registrert i Norsk Kennel Klub i perioden 1986-1988. Alle hundene var klinisk normale da undersøkelsen ble innledet.

Ved 1 års alder ble forkalkede intervertebralskiver påvist hos 34 (29,6%) av hundene. Hos disse var fra 1 til 7 skiver forkalket, med gjennomsnitt på 2,7. Ved 5 års alder ble forkalkede skiver påvist hos 66 (57,4%) av hundene. Hos disse var fra 1 til 11 skiver forkalket, med gjennomsnitt på 3,2. Av hundene som fikk påvist forkalkede skiver ved 1 års alder, hadde 33 (97,1%) forkalkede skiver også ved 5 års alder.

Av totalt 92 forkalkede skiver hos hundene ved 1 års alder, var 29 (31,5%) ikke forkalket 4 år senere. Av totalt 211 forkalkede skiver hos hundene ved 5 års alder, var 148 (70,1%) ikke forkalket 4 år tidligere.

Fra 1 til 5 års alder ble det registrert symptomer på ryggglidelse hos 12 (35,3%) av hundene som hadde forkalkede skiver ved 1 års alder og hos 7 (8,6%) av hundene som ikke hadde forkalkede skiver ved 1 års alder. Av hundene hvor forkalkninger i en eller flere skiver var forsvunnet i løpet av undersøkelsesperioden, ble symptomer på ryggglidelse registrert hos 9 (75,0%).

(Received September 10, 1995; accepted March 7, 1996).

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