Intervertebral Disc Disease in the Dachshund

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Intervertebral Disc Disease in the Dachshund

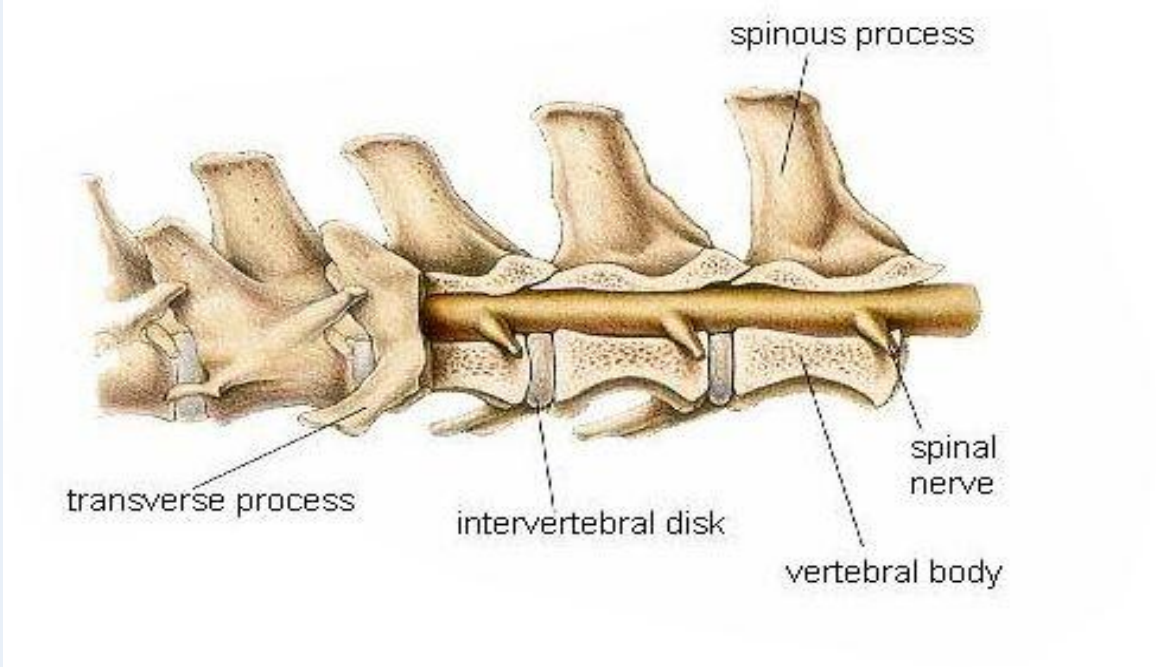
- Overview of IVDD
- Clinical Signs
- Diagnosis
- Treatment
- Prevention

From the Dansk Gravhundeklub website

Overview of IVDD

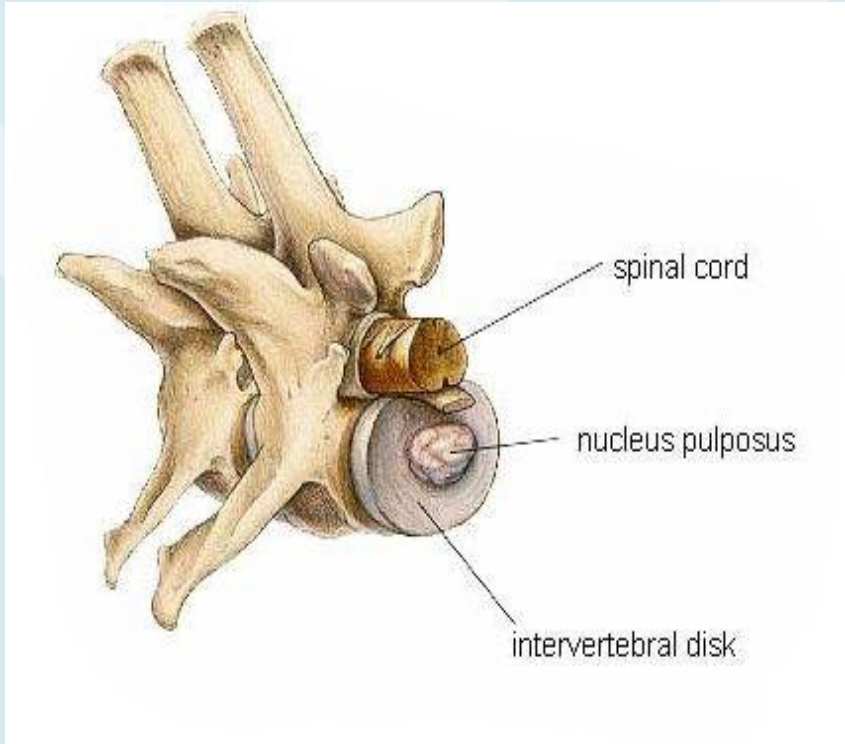
Overview of IVDD

- Normal anatomy
- The intervertebral discs sit between the vertebrae and act as shock absorbers



Overview of IVDD

- Normal anatomy
- Discs have a soft centre (the nucleus pulposus) inside a fibrous ring (the annulus fibrosus)
- The normal nucleus pulposus is a viscous gel
- When surrounded by the tough annulus fibrosus the gel will compress and absorb energy like a shock absorber



Overview of IVDD

- Disc disease
  - First categorised by Hansen in 1952
  - Degeneration of either component of the disc can occur
    - Nucleus pulposus degeneration
    - Annulus fibrosus degeneration

Overview of IVDD

- Disc disease
  - First categorised by Hansen in 1952
  - Degeneration of either component of the disc can occur
    - Nucleus pulposus degeneration
      - Hansen Type 1 disease
      - Common in Daschunds
      - Can lead to sudden onset of problems
    - Annulus fibrosus degeneration

Overview of IVDD

- Disc disease
  - First categorised by Hansen in 1952
  - Degeneration of either component of the disc can occur
    - Nucleus pulposus degeneration
    - Annulus fibrosus degeneration
      - Hansen Type 2 disease
      - Unusual in Dachshund
      - Can lead to gradual, progressive onset of problems

Overview of IVDD

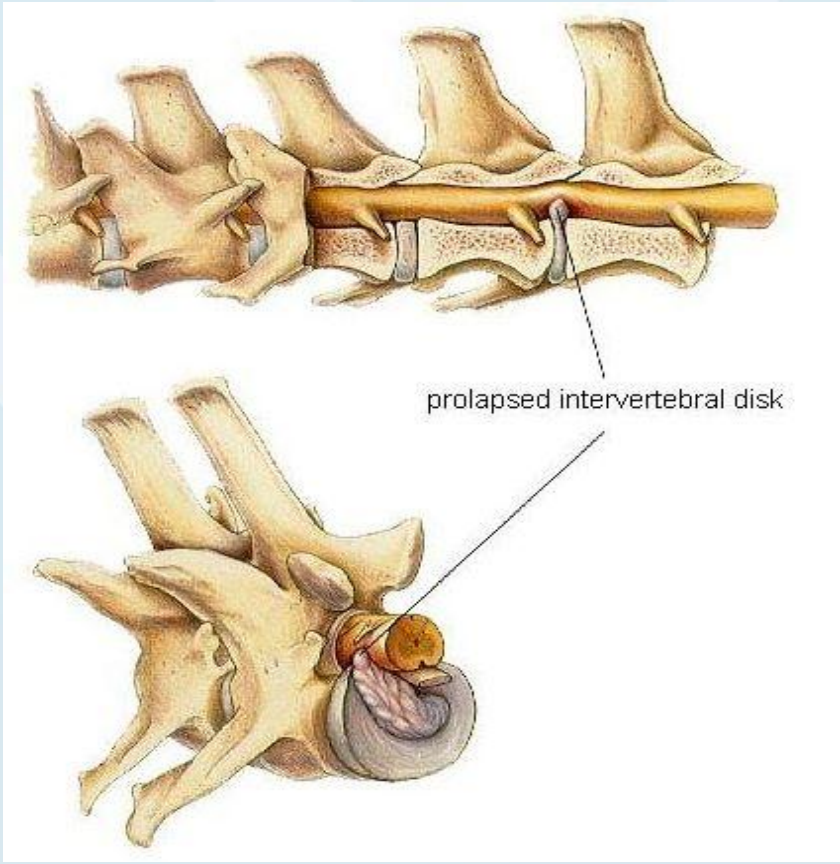
- Type 1 Disease
  - Increased incidence in chondrodystrophic (or more correctly hypochondroplastic) breeds including -
    - Dachshund
    - Pekingese
    - Beagle
    - Spaniel breeds
  - Hypochondroplasia -
    - Gene mutation causes abnormal cartilage production
    - Results in characteristic body shape
    - But..... also contributes towards chondroid metaplasia – the cause of nucleus pulposus degeneration

Overview of IVDD

- Chondroid Metaplasia
  - Results in changes to the nucleus pulposus -
    - Loss of fluid
    - Replacement with cartilage
    - Severely affected discs may become calcified, although this does not always occur
  - The nucleus becomes less compressible
  - This places increased forces on the annulus which begins to degenerate

Overview of IVDD

- Chondroid Metaplasia
- Eventually the annulus ruptures and degenerate nucleus pulposus is extruded into the vertebral canal
- This causes compression of the spinal cord, often resulting in clinical signs
- Lifetime incidence of 18% in Dachshunds (probably more without obvious signs)



Overview of IVDD

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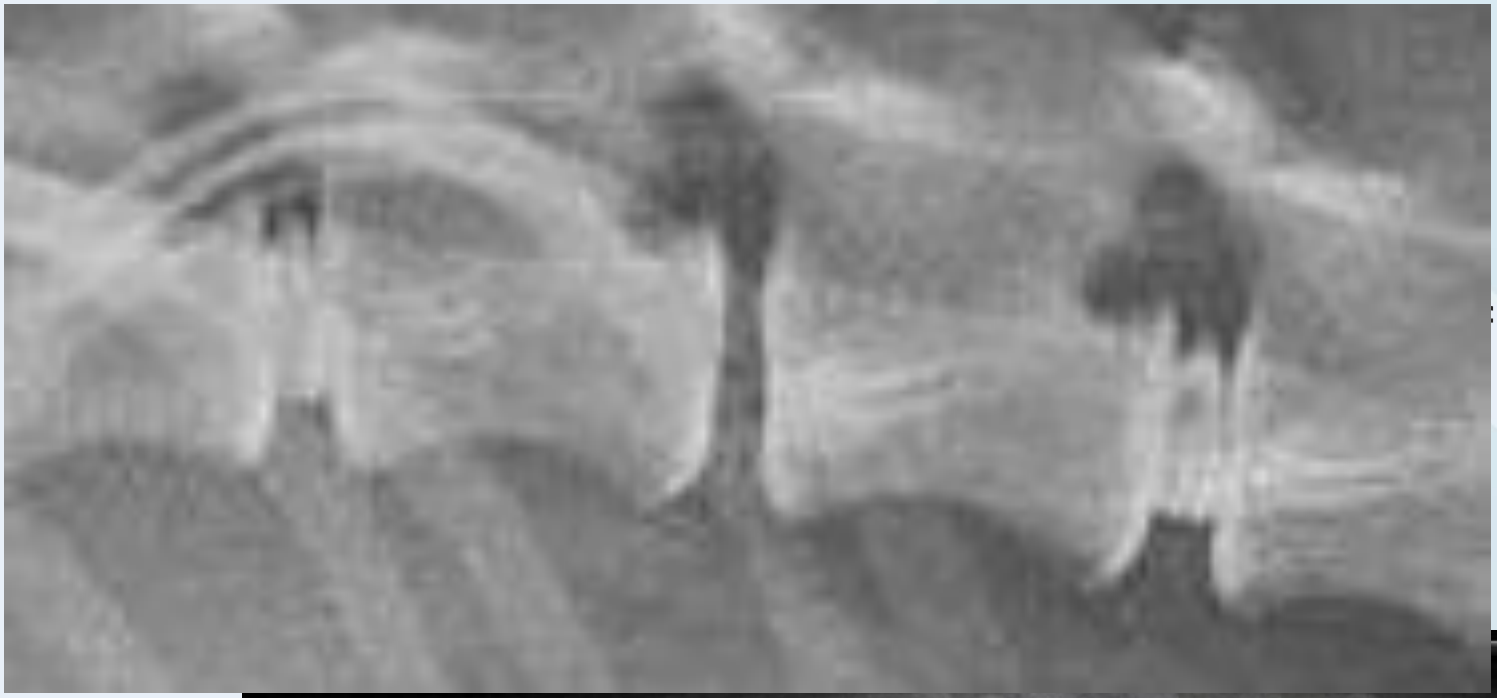


Clinical Signs

Clinical Signs

- What to look out for
  - Pain
  - Incoordination (ataxia)
  - Paralysis

Clinical Signs

- What to look out for
  - Pain
    - Yelping (unprovoked or when handled)
    - Reluctance to jump or climb
    - Arching of the back
    - Low head carriage
    - Reluctance to lower head to eat
    - Reluctance to look upwards
  - Incoordination (ataxia)
  - Paralysis

Clinical Signs

- What to look out for
  - Pain
  - Incoordination (ataxia)
    - Most commonly hindlimbs
    - May affect all four limbs
    - When severe see obvious stumbling, swaying and wobbliness
    - When subtle -
      - Paws may occasionally be placed upsidedown
      - May hear claws scraping on hard ground
      - Incoordination may only be seen on difficult terrain
  - Paralysis

Clinical Signs

- What to look out for
  - Pain
  - Incoordination (ataxia)
  - Paralysis
    - Usually hindlimbs although occasionally all four limbs
    - Commonly preceded by incoordination
    - May be associated with urinary incontinence

Clinical Signs

- Neurological Grading
  - Grade 1 - Pain Only
  - Grade 2 - Ataxia / muscle weakness - walking
  - Grade 3 - Muscle weakness - not walking
  - Grade 4 - Paralysis with pain sensation
  - Grade 5 - Paralysis without pain sensation

Clinical Signs

- What to do!
  - Seek advice from your vet
    - Paralysis or rapid progression of signs should be considered emergencies
    - Pain or mild non-progressive ataxia warrant urgent (same or next day) veterinary examination

Diagnosis

Diagnosis

- Initial Assessment
  - Clinical examination
    - Establish the problem as neurological
    - Assess any concurrent problems
      - General health
      - Orthopaedic examination
  - *Disc extrusion cannot be diagnosed on the basis of clinical examination alone -*
    - There are many causes of back pain and neurological signs other than disc extrusion

Diagnosis

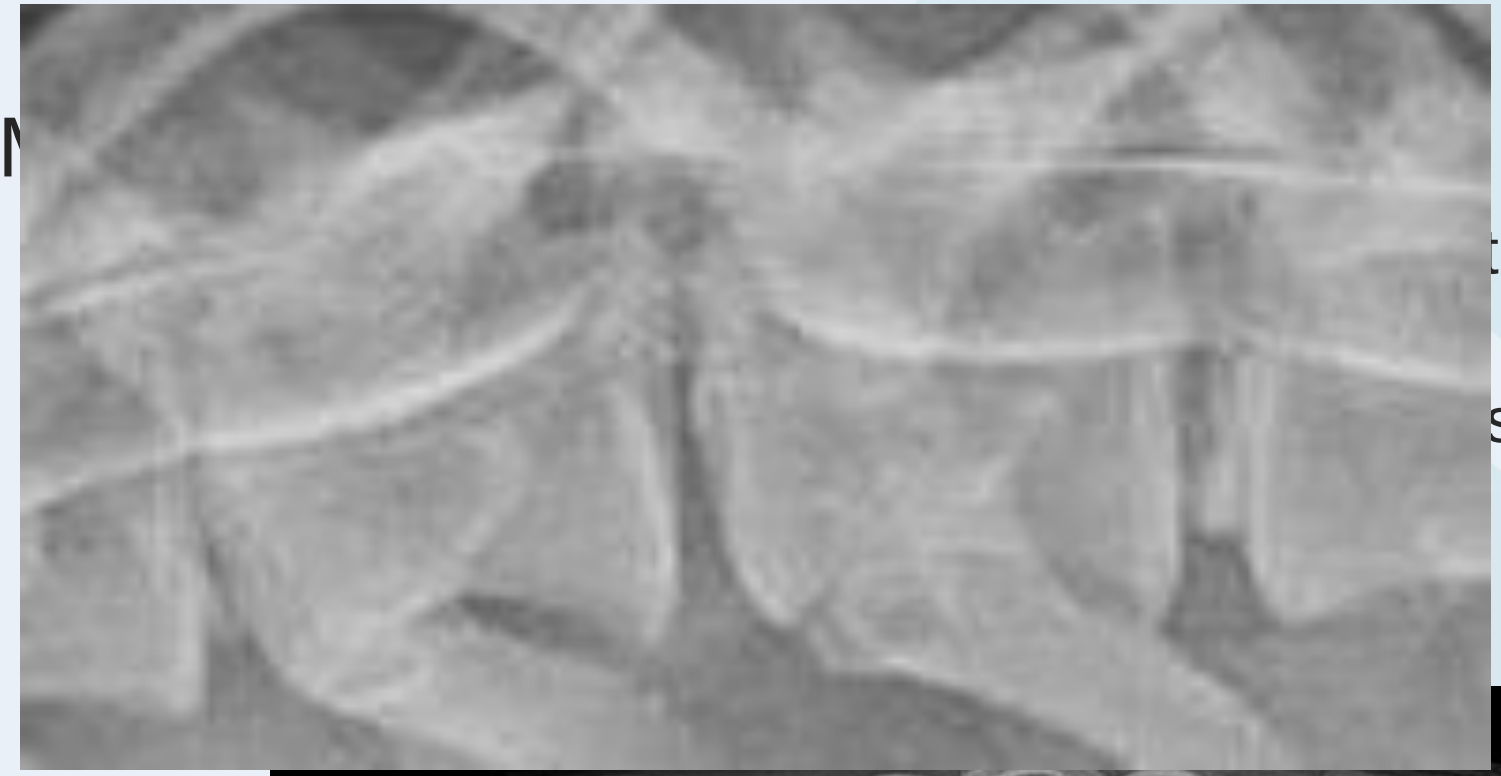
- Initial Assessment
  - X-Rays
    - **Of limited value -**
    - The spinal cord does not show up on X-Rays
    - Disc calcification indicates the presence of disc degeneration, not extrusion
    - A narrowed intervertebral disc space indicates that extrusion has occurred.... but not necessarily recently
  - *Cord compression by disc extrusion cannot be diagnosed by X-Rays*
    - **Consider immediate referral before X-Rays**

Diagnosis

- Diagnosis
  - Assessment of spinal cord compression can be made by-
    - Myelography
    - MRI examination
    - CT examination

Diagnosis

- M



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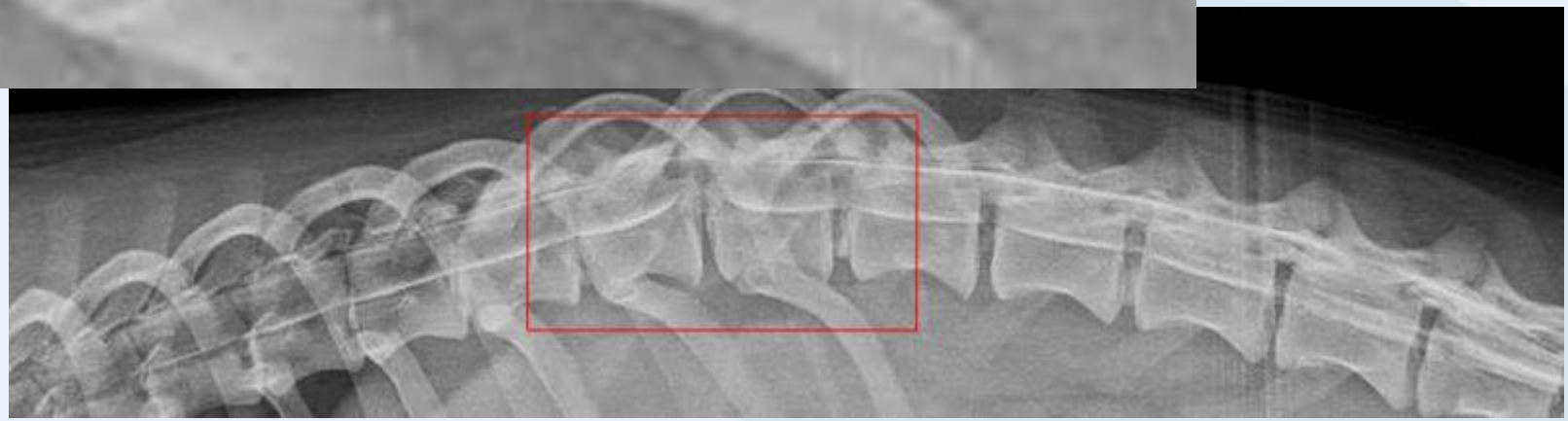
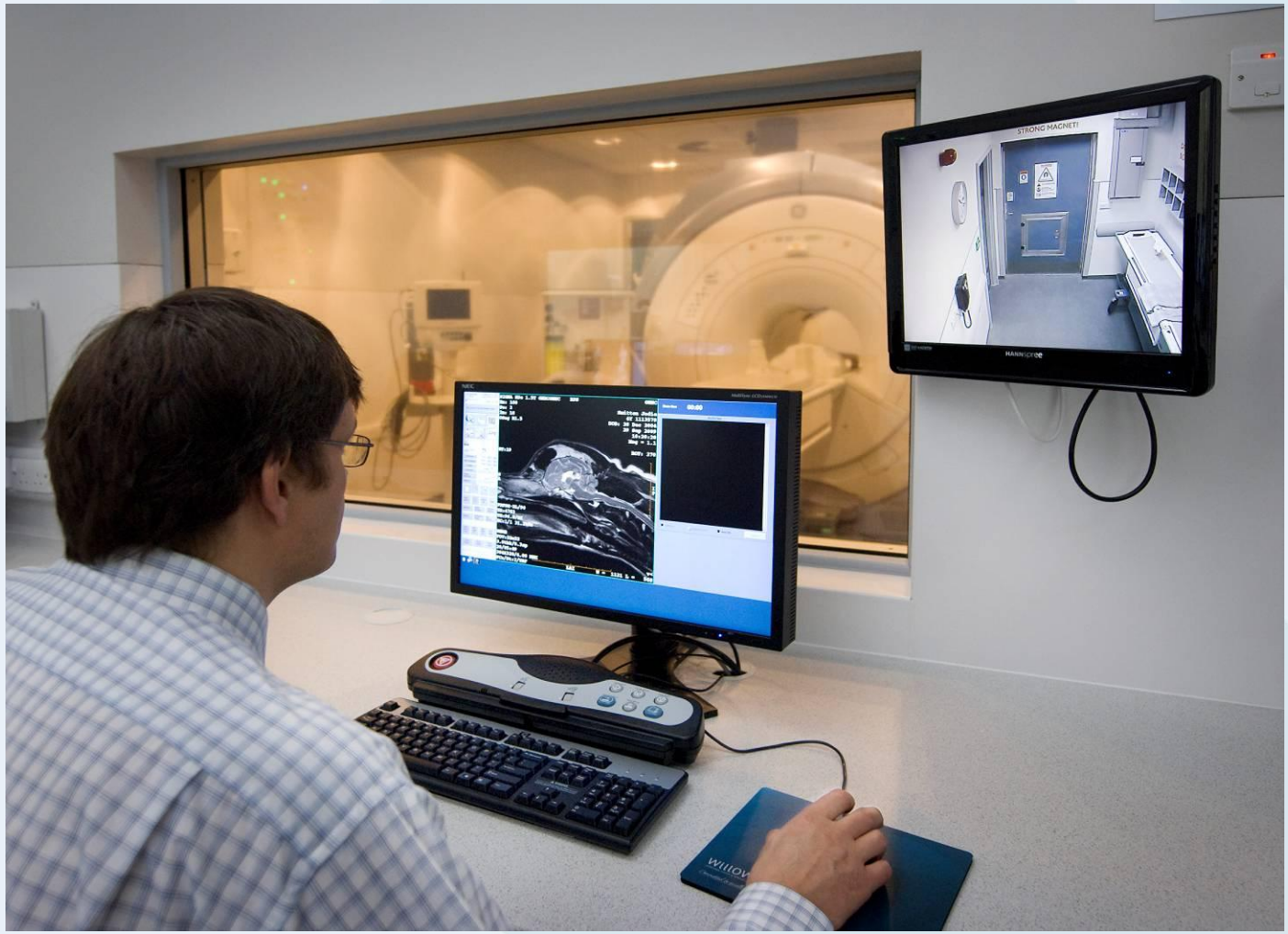


Diagnosis

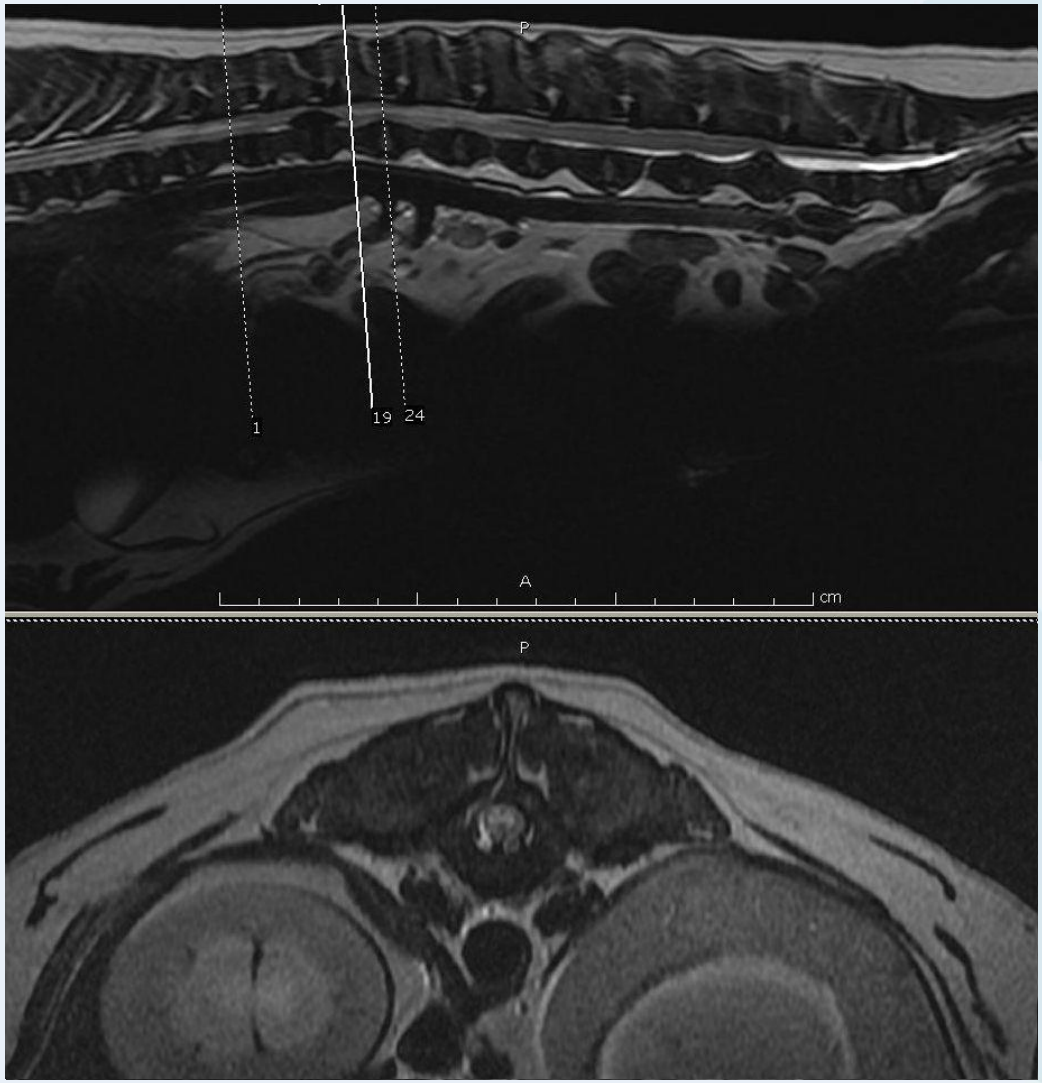
- MRI (Magnetic Resonance Imaging)
  - A very strong magnet causes the atoms within tissues to emit radio waves
  - These are measured and are used to make a 3-D image of the body
  - Provides cross-sectional images of spinal cord and discs
  - Safe

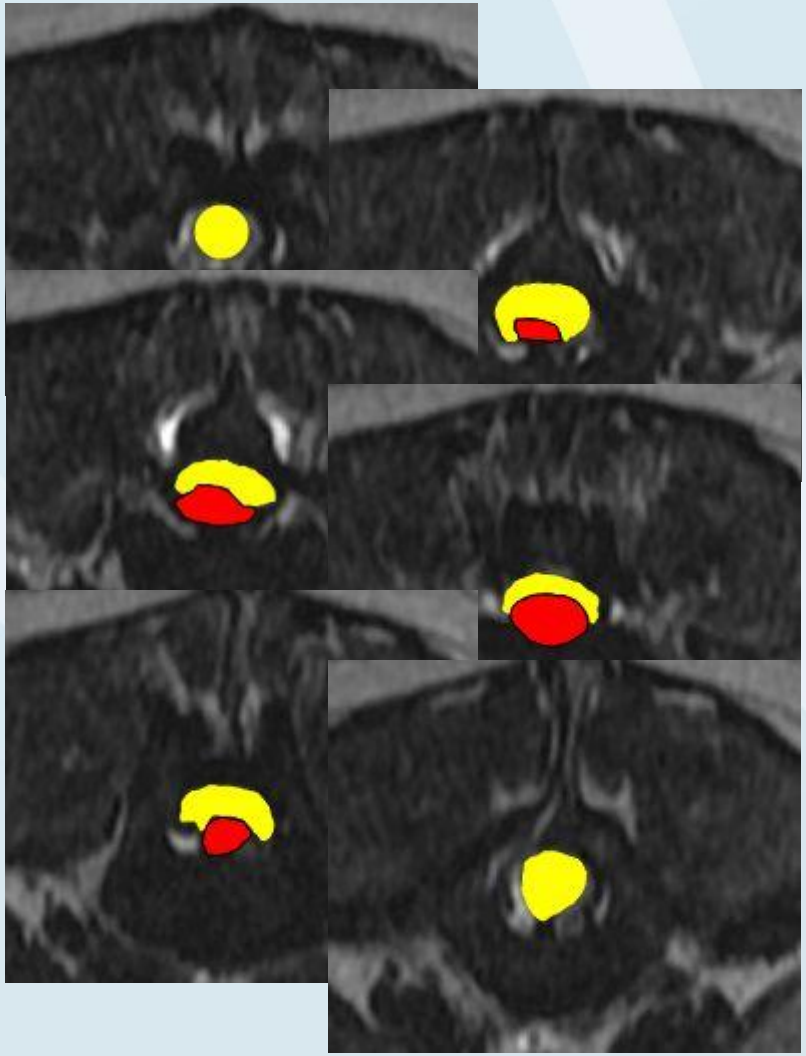
Diagnosis

- MRI



Diagnosis

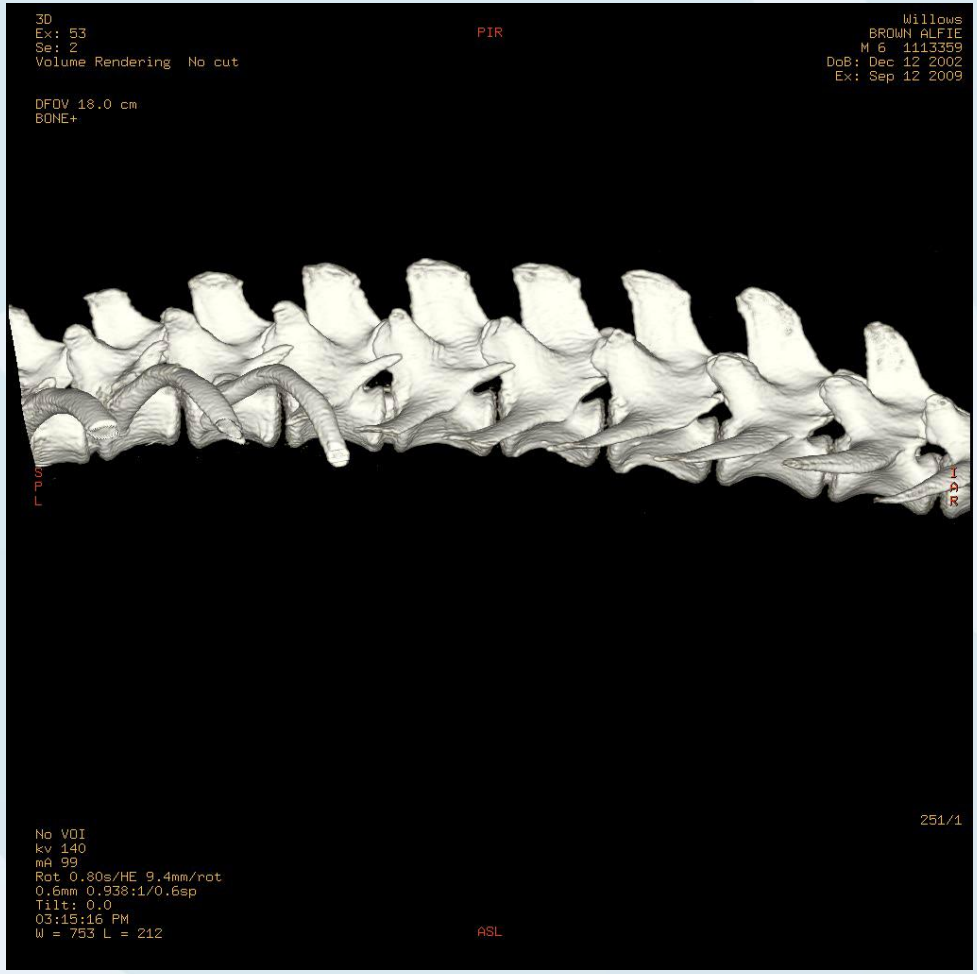




Diagnosis

- CT (Computed Tomography)

- A 3-D X-Ray
- Rapid and accurate imaging of the bones of the spine
- Computer processing allows soft tissues to be seen
- Safe



Diagnosis

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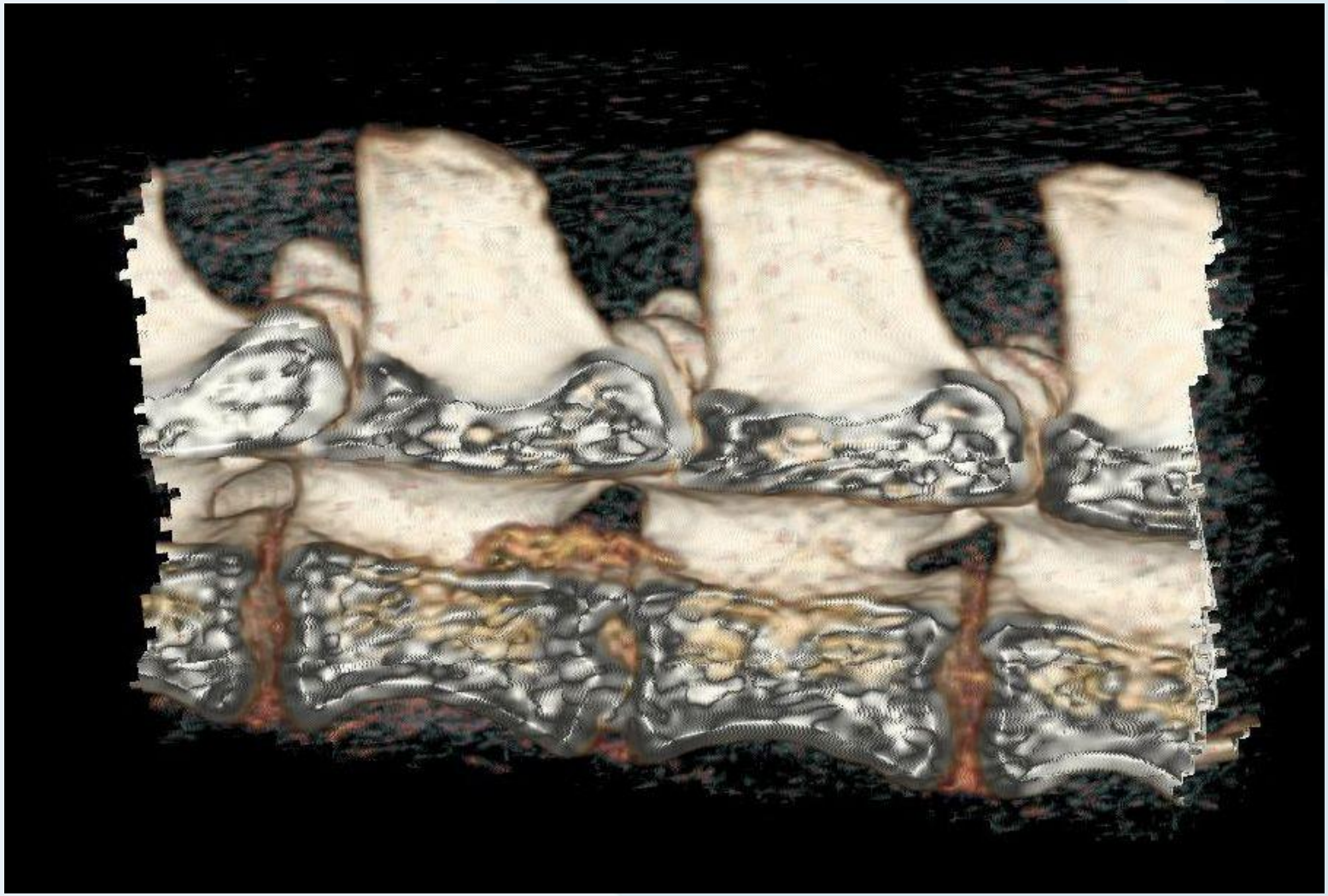
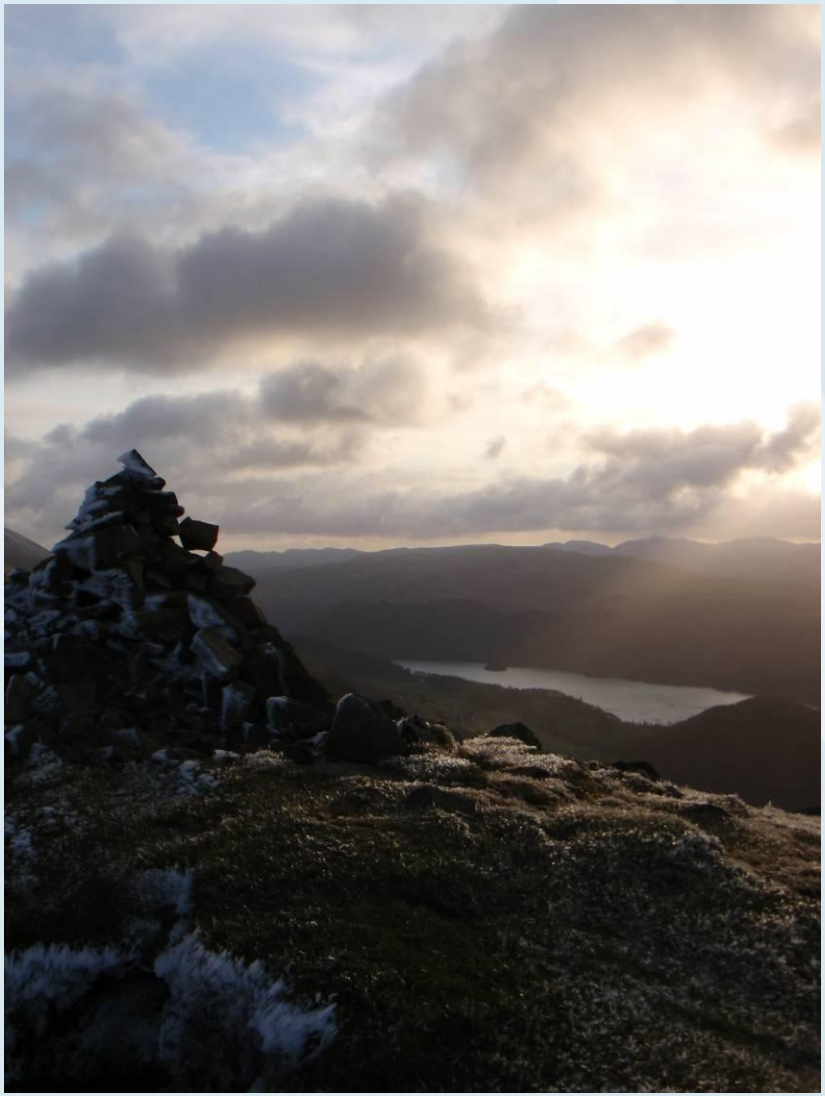


Treatment



Treatment

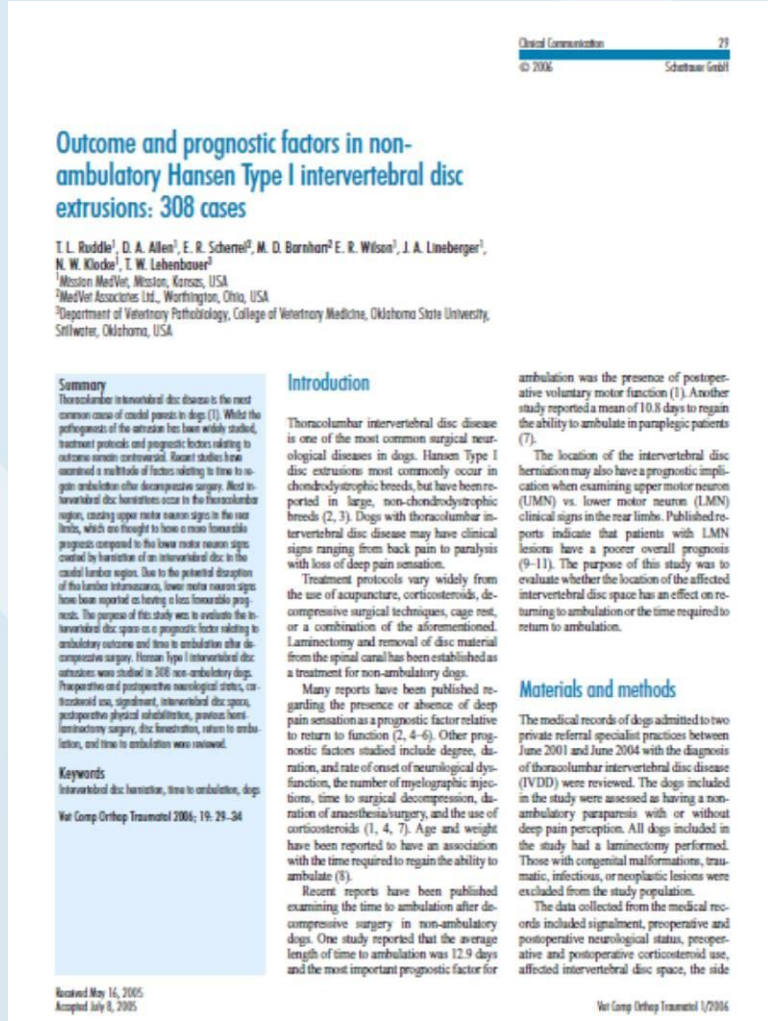
- Treatment Options
  - Non-Surgical
  - Surgical

Treatment

- Treatment Options
  - Non-Surgical
    - Can be considered if -
      - Mild pain
      - No ataxia
      - First episode of problems
    - Cage rest 4 weeks, then limited exercise further 2 months
    - Nearly all dogs improve.....
    - BUT..... Up to 34% will have further extrusion of disc material

Treatment

- Treatment Options
  - Non-Surgical
- Steroids???
- Ruddle (VCOT 2006) reviewed outcomes in 250 dogs (including 141 Dachshunds) paralysed as a result of disc extrusion and treated surgically
- Outcomes were no different in dogs that were or were not given steroids



Clinical Communication 29

Outcome and prognostic factors in non-ambulatory Hansen Type I intervertebral disc extrusions: 308 cases

T. L. Ruddle[1], D. A. Allen[1], E. R. Schenel[2], M. D. Barnhart[3] E. R. Wilson[3], J. A. Lineberger[1], N. W. Klocke[1], T. W. Lehenbauer[3]
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[3]Department of Veterinary Pathobiology, College of Veterinary Medicine, Oklahoma State University, Stillwater, Oklahoma, USA

Summary
Thoracolumbar intervertebral disc disease is the most common cause of caudal paresis in dogs (1). Whilst the pathogenesis of the extrusion has been widely studied, treatment protocols and prognostic factors relating to outcome remain controversial. Recent studies have examined a multitude of factors relating to time to regain ambulation after decompressive surgery. Most intervertebral disc herniations occur in the thoracolumbar region, causing upper motor neuron signs in the rear limbs, which are thought to have a more favourable prognosis compared to the lower motor neuron signs created by herniation of an intervertebral disc in the caudal lumbar region. Due to the potential disruption of the lumbar intumescence, lower motor neuron signs have been reported as having a less favourable prognosis. The purpose of this study was to evaluate the intervertebral disc space as a prognostic factor relating to ambulatory outcome and time to ambulation after decompressive surgery. Hansen Type I intervertebral disc extrusions were studied in 308 non-ambulatory dogs. Preoperative and postoperative neurological status, corticosteroid use, signalment, intervertebral disc space, postoperative physical rehabilitation, previous hemilaminectomy surgery, disc fenestration, return to ambulation, and time to ambulation were reviewed.

Keywords
Intervertebral disc herniation, time to ambulation, dogs

Vet Comp Orthop Traumatol 2006; 19: 29–34

Introduction

Thoracolumbar intervertebral disc disease is one of the most common surgical neurological diseases in dogs. Hansen Type I disc extrusions most commonly occur in chondrodystrophic breeds, but have been reported in large, non-chondrodystrophic breeds (2, 3). Dogs with thoracolumbar intervertebral disc disease may have clinical signs ranging from back pain to paralysis with loss of deep pain sensation.

Treatment protocols vary widely from the use of acupuncture, corticosteroids, decompressive surgical techniques, cage rest, or a combination of the aforementioned. Laminectomy and removal of disc material from the spinal canal has been established as a treatment for non-ambulatory dogs.

Many reports have been published regarding the presence or absence of deep pain sensation as a prognostic factor relative to return to function (2, 4–6). Other prognostic factors studied include degree, duration, and rate of onset of neurological dysfunction, the number of myelographic injections, time to surgical decompression, duration of anaesthesia/surgery, and the use of corticosteroids (1, 4, 7). Age and weight have been reported to have an association with the time required to regain the ability to ambulate (8).

Recent reports have been published examining the time to ambulation after decompressive surgery in non-ambulatory dogs. One study reported that the average length of time to ambulation was 12.9 days and the most important prognostic factor for ambulation was the presence of postoperative voluntary motor function (1). Another study reported a mean of 10.8 days to regain the ability to ambulate in paraplegic patients (7).

The location of the intervertebral disc herniation may also have a prognostic implication when examining upper motor neuron (UMN) vs. lower motor neuron (LMN) clinical signs in the rear limbs. Published reports indicate that patients with LMN lesions have a poorer overall prognosis (9–11). The purpose of this study was to evaluate whether the location of the affected intervertebral disc space has an effect on returning to ambulation or the time required to return to ambulation.

Materials and methods

The medical records of dogs admitted to two private referral specialist practices between June 2001 and June 2004 with the diagnosis of thoracolumbar intervertebral disc disease (IVDD) were reviewed. The dogs included in the study were assessed as having a non-ambulatory paraparesis with or without deep pain perception. All dogs included in the study had a laminectomy performed. Those with congenital malformations, traumatic, infectious, or neoplastic lesions were excluded from the study population.

The data collected from the medical records included signalment, preoperative and postoperative neurological status, preoperative and postoperative corticosteroid use, affected intervertebral disc space, the side

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Treatment

- Treatment Options
  - Non-Surgical

- Levine (JAVMA 2008) reviewed outcomes in 161 dogs (including 87 Dachshunds) treated surgically
- Outcomes were no different in dogs that were or were not given steroids
- Dogs given Dexamethasone were 3.4 times as likely to have a complication including urinary tract infection or diarrhoea

Adverse effects and outcome associated with dexamethasone administration in dogs with acute thoracolumbar intervertebral disk herniation: 161 cases (2000–2006)

Jonathan M. Levine, DVM, DACVIM; Gwendolyn J. Levine, DVM; Lindsay Boozer, BSA; Scott J. Schatzberg, DVM, PhD, DACVIM; Simon R. Platt, DVM, DACVIM; Marc Kent, DVM, DACVIM; Sharon C. Kerwin, DVM, MS, DACVS; Geoffrey T. Fosgate, DVM, PhD, DACVPM

Objective—To determine complications and neurologic outcomes associated with dexamethasone administration to dogs with surgically treated thoracolumbar intervertebral disk herniation, compared with dogs not receiving dexamethasone.

Design—Retrospective case series.

Animals—161 dogs with surgically confirmed thoracolumbar disk herniation.

Procedures—Medical records from 2 hospitals were used to identify dogs that had received dexamethasone < 48 hours prior to admission (dexamethasone group dogs), dogs that received glucocorticoids other than dexamethasone < 48 hours prior to admission (other-glucocorticoid group dogs), and dogs that received no glucocorticoids (nontreatment group dogs). Signalment, neurologic injury grade, laboratory data, and complications were extracted from medical records.

Results—Dexamethasone group dogs were 3.4 times as likely to have a complication, compared with other-glucocorticoid or nontreatment group dogs. Dexamethasone group dogs were 11.4 times as likely to have a urinary tract infection and 3.5 times as likely to have diarrhea, compared with other-glucocorticoid or nontreatment group dogs. No differences in neurologic function at discharge or recheck evaluation were detected among groups.

Conclusions and Clinical Relevance—Results indicated that treatment with dexamethasone before surgery is associated with more adverse effects, compared with treatment with glucocorticoids other than dexamethasone or no treatment with glucocorticoids, in dogs with thoracolumbar intervertebral disk herniation. In this study population, no difference in outcome was found among groups. These findings suggest that the value of dexamethasone administration before surgery in dogs with thoracolumbar disk herniation should be reconsidered. (*J Am Vet Med Assoc* 2008;232:411–417)

Intervertebral disk herniation is the most common cause of acute spinal cord injury in dogs and according to the findings in 1 study[1] leads to 2.3% of hospitalizations of all dogs.[2,3] Primary and secondary spinal cord injury can occur as a result of disk herniation.[4–6] Primary injury refers to the initial mechanical insult to the spinal cord and can consist of compression, concussion, contusion, and laceration.[7] Secondary injury is the biochemical cascade that results from the primary insult and involves components of oxidative stress, excitotoxicity, inflammation, and vascular dysregulation.[4,7] Surgical removal of herniated disk material often is performed in dogs with severe myelopathy, as it likely aids in relieving ongoing compression-related primary injury and may prevent the exacerbation of secondary processes. Treatment of secondary spinal cord injury is an active area of clinical and experimental research in veterinary and human medicine. High doses of glucocorticoids are the most widely used, commonly investigated, and frequently debated treatment for secondary injury.[8]

Experimental and clinical evidence exists supporting the use of high doses of glucocorticoids for acute spinal cord injury.[9] High-dose glucocorticoid treatment is believed to contribute to neuronal protection principally by inhibiting lipid peroxidation, which may improve mitochondrial metabolism, preserve spinal cord blood flow, favorably alter ionic homeostasis, and reduce the amount of excitotoxic glutamate release.[9–12] Results of various studies[13–17] of rats with spinal cord injury support the benefits of high-dose methylprednisolone and high-dose dexamethasone administration, showing improved motor recovery when treatment is provided soon

From the Departments of Small Animal Clinical Sciences (JM Levine, GJ Levine, Kerwin) and Veterinary Integrative Biosciences (Fosgate), College of Veterinary Medicine and Biomedical Sciences, Texas A&M University, College Station, TX 77843; and the Department of Small Animal Medicine and Surgery, College of Veterinary Medicine, University of Georgia, Athens, GA 30602 (Boozer, Schatzberg, Platt, Kent).

Address correspondence to Dr. Jonathan Levine.

Abbreviations

TAMU	Texas A&M University
UGA	University of Georgia
UTI	Urinary tract infection
CI	Confidence interval

Treatment

- Treatment Options
  - Non-Surgical

- The use of any form of steroids is not currently recommended either as part of conservative management or prior to surgery

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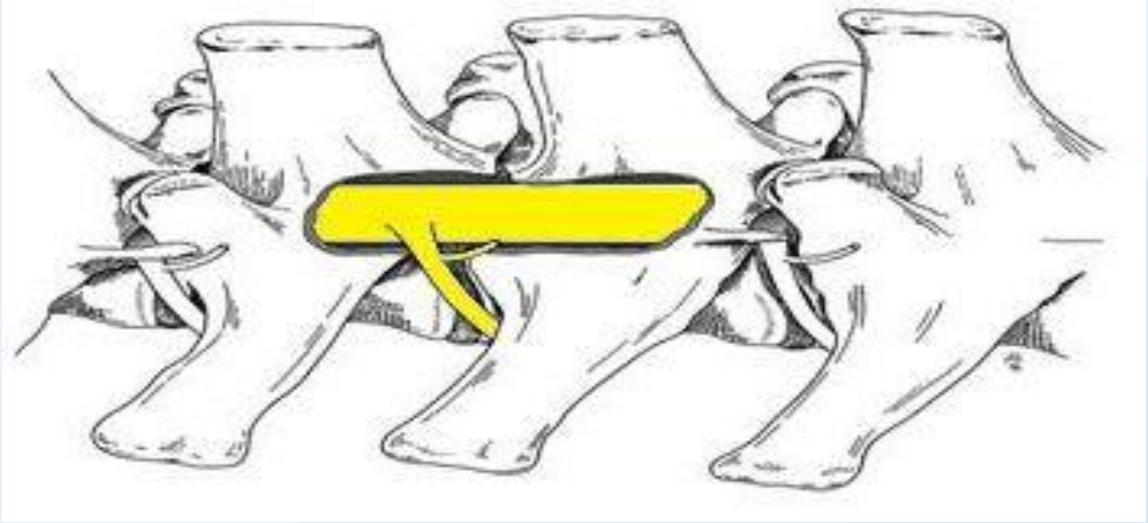
Treatment

- Treatment Options
  - Surgical
    - Most ataxic or paralysed dogs
    - Dogs with pain not responding to conservative treatment
    - Over 90% of ataxic or paralysed dogs recover after surgery -
      - Dogs with more severe signs may have residual deficits
      - Recovery may take several weeks
      - Intensive nursing required if paralysed +/- incontinent
    - Paralysed dogs without pain sensation have a worse prognosis
      - Between 50 and 60% are expected to recover the ability to walk
      - Prompt surgery is essential (under 24 hours)

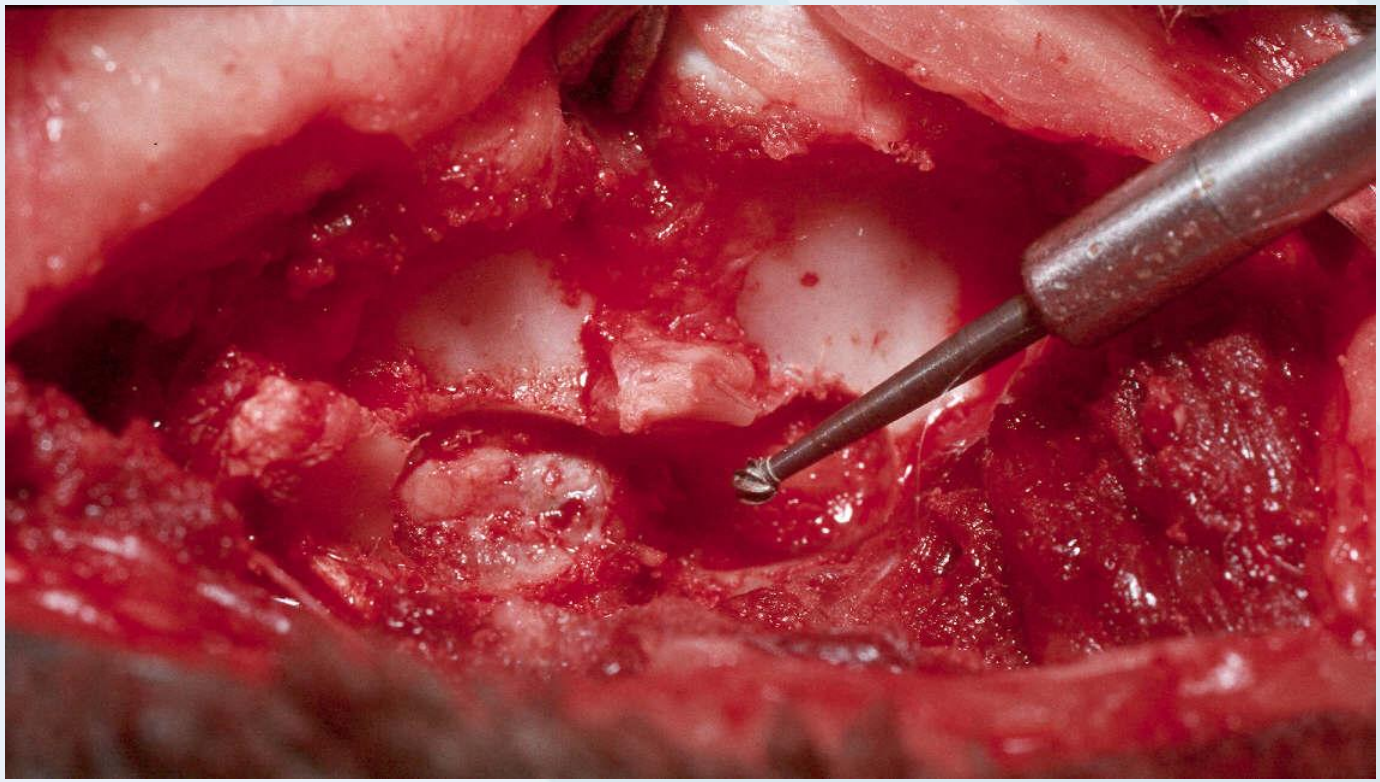
Treatment

- Surgical Treatment
  - A window is created in the vertebra to allow access to the spinal cord
  - This is usually done from the side of the bone in the back, although in the neck the underside of the bone is used
  - Extruded disc material is carefully retrieved from around the cord



Treatment

- Surgical Treatment
  - Hemilaminectomy



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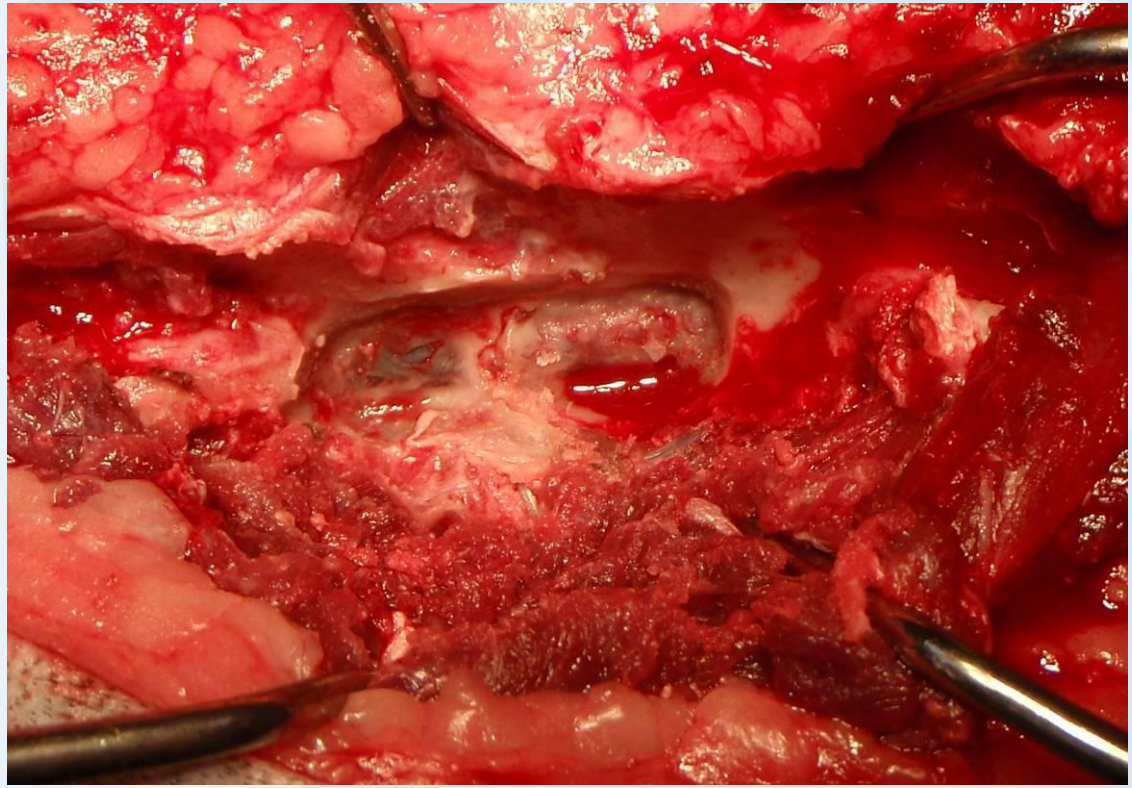

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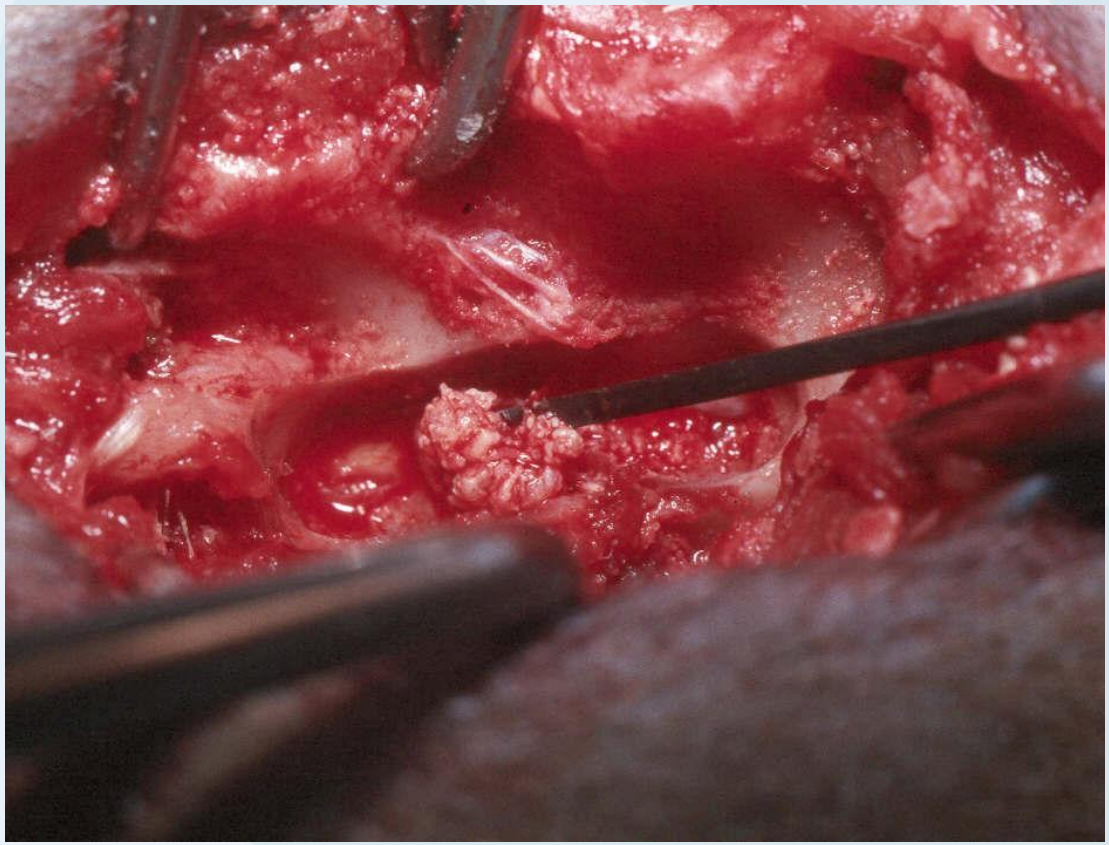

Treatment

- Treatment Outcomes

Neurological Grade	Non-surgical treatment	Surgical Treatment
1 - Pain Only	100%	97%
2 - Ataxia / Weakness - walking	84%	95%
3 - Weakness - not walking	84%	93%
4 - Paralysis - with pain sensation	81%	95%
5 - Paralysis - no pain sensation	7%	64%

Neurological Grade	Non-surgical treatment	Surgical Treatment
Recurrence Rate	34-40%	0-15%

Prevention

Prevention

- Genetics
  - Heritability of disc disease
    - Much recent work by Vibeke Jensen in Denmark
    - She showed disc degeneration to be highly heritable in Dachshunds (heritability estimate, 0.47 to 0.87)
    - Heritability of 1 indicates that all variation is genetic in origin and a heritability of 0 indicates that none of the variation is genetic
    - Incidence varies significantly between different lines

Prevention

- Genetics
  - Mechanism of inheritance
    - Not a single gene (e.g. ABO blood group in humans)
    - Severity of disc disease determined by the effects of several genes and environmental factors
    - Dachshund body shape does not promote disc degeneration
    - Hypochondroplasia gene.....
      - .....is thought to be a major genetic factor in the development of chondroid metaplasia.....
      - .....but is responsible for the typical Dachshund conformation
      - So can we keep one without the other.....??

Prevention

- Genetics
  - Mechanism of inheritance
    - Probably!
    - Since several genes are involved, a reduction in the prevalence of disc disease should be possible by selective breeding without changing the characteristics of the breed

Prevention

- Breeding Programs
  - Criteria for success
    - The characteristic must have a significant genetic basis
      - Heritability estimate
    - The characteristic must be measurable before the animal breeds
    - Measurement of the characteristic must be accurate
    - A high proportion of the population must take part
    - Affected dogs must not be used for breeding

The story of hip dysplasia.....

Prevention

- Breeding Programs
  - Criteria for success
    - Cannot use disc rupture itself as measured characteristic -
      - Disc disease may not manifest until after breeding
      - Some dogs with severe disc degeneration will never show signs, but will pass on the problem
    - We need an early measure of the severity of disc degeneration in a potential breeding dog
    - Disc calcification has been suggested
      - Known to be related to severe degeneration
      - Can be measured with an X-Ray at 2 years of age
    - BUT... Is disc rupture strongly associated with disc calcification?

Prevention

- Jensen *et al* (JAVMA 2008)
- 61 Dachshunds -
  - All X-Rayed when 2 years old
  - Surviving dogs X-Rayed at 8 years old
  - All episodes of disc rupture causing disease or death recorded
- 22 dogs had had disc extrusion diagnosed
- The number of calcified discs decreased with age
  - Must screen early
  - Nearly 50% of calcified discs probably extruded (some without signs)

SMALL ANIMALS

Quantification of the association between intervertebral disk calcification and disk herniation in Dachshunds

Vibeke F. Jensen, DVM, PhD; Sarah Beck, DVM; Knud A. Christensen, PhD; Jens Arnbjerg, DVM

Objective—To quantify the association between intervertebral disk calcification and disk herniation in Dachshunds.

Design—Longitudinal study.

Animals—61 Dachshunds that had been radiographically screened for calcification of intervertebral disks at 2 years of age in other studies. Thirty-seven of the dogs had survived to the time of the present study and were ≥ 8 years of age; 24 others had not survived.

Procedures—Radiographic examination of 36 surviving dogs was performed, and information on occurrence of disk calcification at 2 years of age were obtained from records of all 61 Dachshunds. Information on occurrence of disk herniation between 2 and 8 years of age was obtained from owners via questionnaire. Associations between numbers of calcified disks and disk herniation were analyzed via maximum likelihood logistic regression.

Results—Disk calcification at 2 years of age was a significant predictor of clinical disk herniation (odds ratio per calcified disk, 1.42; 95% confidence interval, 1.19 to 1.81). Number of calcified disks in the full vertebral column was a better predictor than number of calcified disks between vertebrae T10 and L3. Numbers of calcified disks at ≥ 8 years of age and at 2 years of age were significantly correlated.

Conclusions and Clinical Relevance—Number of calcified disks at 2 years of age was a good predictor of clinical disk herniation in Dachshunds. Because of the high heritability of disk calcification, it is possible that an effective reduction in occurrence of severe disk herniation in Dachshunds could be obtained by selective breeding against high numbers of calcified disks at 2 years of age. *J Am Vet Med Assoc* 2008;233:1090–1095)

Intervertebral disk herniation occurs in most breeds of dogs, but the occurrence is far more frequent in certain breeds characterized by hypochondroplastic dwarfism (also known as chondrodystrophic breeds). Dachshunds are particularly at risk,[1–3] with an estimated lifetime incidence of clinical disk herniation of 18%.[3,3] Subclinical disk herniation in Dachshunds is likely even more common, although the true incidence is unknown.[4] The predisposition to intervertebral disk herniation is caused by severe degeneration of the intervertebral disk, which is preceded by chondroid metaplasia emerging from the periannular zone. In Dachshunds, chondroid metaplasia emerges from the perinuclear zone throughout the vertebral column when dogs are a few months old.[1,5] The severity of the degenerative process varies within and among dogs.[1,6] The process itself is complex, with a multifactorial etiology that involves genetic and mechanical factors as well as effects of aging.[6]

From the Department of Microbiology and Risk Assessment, The National Food Institute, Technological University of Denmark, 2860 Søborg, Denmark (Jensen); Falke Veterinary Clinic, Ermitagevej 53, DK-4700 Næstved, Denmark (Beck); and the Departments of Small Animal Clinical Sciences (Arnbjerg) and Basic Veterinary and Animal Science (Christensen), Faculty of Life Sciences, University of Copenhagen, DK-1165 Copenhagen K, Denmark.

The authors thank Dr. Helle M. Sommer for assistance with statistical analyses.

Address correspondence to Dr. Jensen.

Abbreviations

AIC	Akaike Information Criterion
CI	Confidence interval
OR	Odds ratio

The strong phenotypic relationship between chondroid metaplasia and hypochondroplastic dwarfism suggests that a major genetic factor in chondroid metaplasia is attributable to a pleiotropic effect of the hypochondroplasia gene. It is unlikely that the conditions are caused by 2 distinct genes because that would imply a specific founder effect in multiple breeds. Furthermore, both conditions are characterized by abnormal chondrocyte differentiation.[6] In Dachshunds, severe disk degeneration with calcification is reportedly highly heritable (heritability estimate, 0.47 to 0.87).[10] This high heritability of disk calcification was estimated in Dachshunds via plain radiography performed during the optimum period (ie, at 24 to 30 months of age, when the number of visibly calcified disks appears to reach a maximum).[11] Heritability of disk calcification within the breed indicates involvement of genes other than the gene encoding hypochondroplasia. Furthermore, disk degeneration with calcification in dogs with severe disease appears to be continuous in nature, which suggests that the degenerative disease is a multifactorial trait.[8,12]

An association between disk calcification and disk herniation appears logical because both conditions are

Prevention

- Odds of clinical disc rupture increase by 1.42 for each calcified disc
- The risk of euthanasia due to disc disease was -
  - 5% when 4 or less calcified discs
  - 37% when > 4 calcified discs

Number of calcified discs	Total number of dogs	Dogs with extrusion	Dogs without extrusion
0, 1 or 2	26	3 (11%)	23 (89%)
3 or 4	16	7 (43%)	9 (57%)
5 or more	19	12 (63%)	7 (37%)

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Prevention

- Jensen et al (JAVMA 2008)

- In summary -
- There is a quantitative association between the number of calcified discs at 2 years of age and occurrence of disc extrusion

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Prevention

- Breeding Programs
- Danish Dachshund Club
- Initially a voluntary scheme
- Screening between 2 and 4 years old
- Breeding recommended only when 0,1 or 2 calcified discs
- If 3 or 4 discs -
  - Only one litter
  - Other parent must have <3 calcified discs
- Should not breed if >4 calcified discs

Prevention

- Breeding Programs
- Danish Kennel Club
- From 1st July 2009 litters can only be registered if both parents satisfy the Club scheme criteria
- Some of the problems of HD scheme avoided -
  - Not voluntary!!
  - Registration is binding
  - The owner may not ask the vet to rule on the number of calcifications
  - Test results are published

Prevention

- Breeding Programs
- Danish Kennel Club
- Dogs are given a K-score between 0 and 9 according to the number of calcified discs present
- Too early to know if the program will be successful

Hodja's edible Sille	14266/97	RS	bitch Hodja's Garibaldi, 07763/90	Hodja's Fellipa Fie, 22732/89	(K1)
Hodja's Øline Female	18577/97	RS	bitch Semper's Eminent, 11824/88	Hodja's Ultra Wolf, 14546/95	(K0)
Iben Lund's Cille	20394/2001	RS	bitch Wenja's prosecutor, 04069/2000	Minnie, 09929/94	(K4)
Laguna Hycon	21302/99	RS	bitch Rose Lerry vom Grund, PKR IV 16262	Boo Hycon, PKR IV 13747	(K1)
Mathilde	11245/2001	RS	bitch Mikkel Mephisto, 16763/2000	Sille, 13739/96	(K9)
Mokker's Balalajka	16851/2002	RS	bitch Walgaards Humphrey Bogey, 05386/99	Seideman's Uni, 16991/2000	(K4)
NUg-nUg ACNova-Vita	17291/97	RS	bitch Lajtinen's caixer, 20553/92	NUg-nUg Aquila, 16554/87	(K0)
NUg-nUg Aquila	16554/87	RS	bitch Glen Staccato, 30287/80	Kivi, 24627/85	(K1)
NUg-nUg Camteck Fuga	19266/91	RS	bitch Wenja's Munter, 20847/90	NUg-nUg Aquila, 16554/87	(K1)
NUg-nUg Camteck Gaya	26417/92	RS	bitch nUg-nUg Camteck Escudo, 27116/90	NUg-nUg Aquila, 16554/87	(K0)

Prevention

- Breeding Programs
  - Criteria for success
    - The characteristic must have a significant genetic basis ✔
      - Heritability estimate
    - The characteristic must be measurable before the animal breeds ✔
    - Measurement of the characteristic must be accurate ✔
    - A high proportion of the population must take part ?
    - Affected dogs must not be used for breeding

The story of ~~hip dysplasia~~.....

IVDD..... is up to you!

Thank You

Any questions?