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Intervertebral Disc Disease in Chondrodystrophic Breeds (Dachshunds)

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Introduction: Disc displacement is a leading cause of disability and death in chondrodystrophic breeds and specifically Dachshunds. Dachshunds undergo early degeneration of all intervertebral discs which predisposes them to rupture and subsequent pain and/or paralysis. In some of these dogs, paralysis is permanent and many dogs will be euthanised due to disc displacement. Early recognition and treatment is critical in many of these patients. Treatment options are numerous with some having more success than others.

Nomenclature: Intervertebral disc displacement has been called many different things including: disc disease, prolapse, rupture, herniation, protrusion, extrusion, bulge and displacement. For consistency, we use the term *intervertebral disc displacement* which is defined as displacement of the intervertebral

disc beyond the bounds of the disc space. In Dachshunds is occurs most frequently following disc degeneration.

Anatomy: The spinal cord lies within a boney tunnel made up of the laminae (walls) of the vertebral bodies. The intervertebral disc separates the adjacent vertebrae. The disc is made up of a central cushion called the nucleus pulposus (from now on called the nucleus) and an external fibrous ring called the annulus fibrosus (from now on called the annulus). The nucleus is about 80% water and acts as a cushion to combat compressive forces between the vertebral bodies. The annulus restricts the expansion of the nucleus and also provides some stability during bending of the spine.

Disc degeneration: Dachshunds are prone to disc degeneration. With degeneration, the matrix of the nucleus loses the ability to hold water and becomes calcified. With calcification, the nucleus can no longer act as a cushion. This means that compressive forces are transferred to the annulus. This is analogous to a flat tire on a car wherein all of the road bumps are transferred directly to the chassis of the car. The annulus becomes thicker in an attempt to stabilise the spine. As the annulus becomes thicker, it loses biomechanical integrity. As a result, the nucleus, which is under pressure, explodes through the annulus. The annulus has a design fault wherein it is thinnest right under the spinal cord. This means that when it explodes, it explodes right on to the spinal cord. This causes both direct concussive damage as well as persistent compression.

Location of disc ruptures: It has been shown that all of the discs degenerate to an equal extent in chondrodystrophic dogs. That begs the question: why do some discs displace with more frequency than others. Two suggestions for this have been proposed. One is that in the thoracic region, the presence of the dorsal longitudinal ligament from T1-T9 prevents the disc from displacing and compressing the cord. The other is that disc stresses tend to be concentrated in the region where the relatively stiff thoracic spine meets the mobile lumbar spine. The most common site for disc rupture is at T13-L1 (the thoracolumbar junction) followed sequentially by adjacent disc spaces.

Prevalence: The first case of disc displacement was described in 1881 characterised by complete hindlimb paralysis in a Dachshund. Priester published the incidence of disc displacement among a hospital population of tens of thousands of dogs. It was estimated that there are approximately 23 cases per 1000 dogs per year. He observed an increased incidence in Dachshunds, Pekingese, shih tsu's, lhasa apso's and beagles. At risk breeds had a peak incidence at 4-6 years whereas breeds not at risk had a peak incidence at 6-8 years of age. Hoerlein reported 2395 cases of which 65% were Dachshunds. It was estimated thatDachshunds have 10 times the risk of any other breed. He noted a peak at 5 years of age and 75% occurred between 3 and 6 years of age. Goggin reported on 536 Dachshunds, with a breed prevalence of 19% and no obvious heritability. He noted that in 25% of dogs, the disease is fatal.

Clinical signs: While most Dachshund owners would be familiar with the clinical signs associated with disc displacement, there are certain factors which should be noted when reporting an incident to a primary care or specialist veterinarian. These include:

- When did the clinical signs start?
- If he/she is paralysed, when was the last time voluntary motor function was present?
- Is he/she posturing to urinate? Able to urinate?
- Have there been previous episodes?
- Has there been a response to medication including pain relievers or antinflammatories?
- If he/she is on pain medication, have stools been black or bloody? Has there been vomiting?

Physical examination: There are very important physical examination parameters which should be noted when suspecting IVDD. These will help determine if referral for further workup is critical and also when monitoring progression following diagnosis or surgery. These include:

- Is there abnormal nail wear in the back feet suggesting long-term disability?

- Is there evidence of forelimb lameness (usually on one side) suggesting nerve root impingement (also known as a root signature)?
- Is there evidence of Schiff-Sherrington posture which is characterised by rigid extension of the forelimbs, usually associated with marked paralysis of the hindlimbs. This is suggestive of a significant injury to the spinal cord in thoracolumbar region. This suggests that immediate referral is critical.
- Is the anus flaccid and the patient is faecally incontinent? This suggests either a very low lesion in the lumbar or lumbosacral spine or possibly descending myelomalacia.

Neurological examination: The purpose of the neurological examination is to try to determine if neurological disease exists and if it does exist, at what anatomical level is the disease or lesion likely to be. Signs of intracranial (brain or brainstem) disease would suggest that IVDD is not likely to be the primary problem and may include:

- Head turn to one direction or the other
- Dullness, stupor or coma
- Circling to one direction or the other
- Head tilt to one direction of the other
- Eyes persistently darting to one side or the other.
- Seizures
- Behavioural change

Is there an increased area of pain in the cervical, thoracic, lumbar or sacral region?

Are the forelimbs functioning normally? If so, then the problem is more likely to be in the thoracolumbar region. If not, then the problem is likely to be in the cervical region. Again, is there limping in one forelimb or the other suggesting nerve root compression.

Is there wobbliness in the back limbs or forelimbs? Does he/she stand with the legs wide apart? Does he/she stand on the tops of the toes (knuckling over)?

One of the most important factors is the presence or absence of superficial or deep pain sensation. This is usually only checked by a veterinarian and is VERY subject to interpretation. The patient does not need to be checked for pain sensation is there is obvious motor function (voluntary movement of the legs). It is critical to differentiate reflex withdrawal of the limb from conscious sensation. Reflex withdrawal of the limb can occur despite complete disruption of the spinal cord and no deep pain sensation. Conscious sensation of pain requires spinal cord function. When the toe is pinched, the patient should vocalise or turn around. Just withdrawing the foot can be a reflex and does not indicate spinal cord function. This is the most important factor when determining prognosis with IVDD.

Myelomalacia: This is a devastating event which occurs in about 1% of patients following severe spinal cord damage. It usually occurs within 24-72 hours of the initial injury. Clinically, it is characterised by expanding neurolocalisation. Patients have flaccid paralysis of the abdominal muscles, hind limbs, tail, anus and/or bladder. There is lack of deep pain sensation in the affected areas. It may progress to respiratory paralysis. Patients are typically excruciatingly painful. The prognosis is grave for affected animals.

Grading IVDD

Grade I - Painful with no neurological deficits.
Grade II - Wobbliness (ataxia) with no weakness
Grade III - Weakness
Grade IV - Paralysis
Grade V - Loss of deep pain sensation

Decision to do surgery - The decision to do surgery is often a difficult one. Financial considerations, concerns over quality of life, risk of recurrence and lack available expertise and/or equipment may deter people from pursuing surgery. Despite all of these factors, for more severe IVDD, nothing approaches surgery in terms of consistency, rate of recurrence and speed of resolution of clinical signs. It should be noted that in Dachshunds, cervical disc ruptures rarely result in permanent paralysis and tolerance to pain is the main determinant for urgency of surgery.

Things that influence our recommendation include the severity of clinical signs, the duration of clinical signs, the time course of clinical signs (are they improving, static or deteriorating. Definite indications for surgery include:

- Paralysis
- Deteriorating neurological signs
- Extended duration of severe pain
- Lack of deep pain sensation

Imaging: The traditional method of imaging spinal cord compression due to disc displacement is conventional myelography wherein a dye is injected into the spinal canal and conventional radiographs (x-rays) are performed.. Sectional imaging (MRI and CT) provide substantially better understanding in terms of determination of the site of compression, the severity of compression, the side of the compression and the amount of disc material which is expected to be removed. In our hospital, CT myelography is the standard of care. Disadvantages of CT when compared with MRI include:

- The need for myelography (myelography is quite safe but there are some minor complications which can occur)
- MRI provides more detail

Disadvantages of MRI include:

- Potential to over interpret compression
- Limited availability
- Long duration of anaesthetic
- Because of these disadvantages, MRI is rarely used as a primary diagnostic test for disc disease in animals.

We find CT to be extremely useful in diagnosing spinal cord compression. CT myelography takes only about 10minutes, compared with 1-2 hours for MRI.

Surgery

The objectives of surgery include decompressing the spinal cord, preventing of recurrence at the affected site and preventing damage to the spinal cord as a result of manipulation. The success of surgery for cervical and thoracolumbar disc displacement is 95-98% as long as deep pain sensation is present. When deep pain sensation is absent, the prognosis is still about 75% for recovery in dachshunds. If deep pain is present, in our practice, most dogs are discharged within 48 hours, regain some motor function within a few days, are partially ambulatory within one week and almost all dogs are ambulatory within one month.

Conservative management: Acceptable in dogs with mild neurological deficits, those which are improving and those which have manageable pain. The components of conservative management include strict cage confinement, pain relief, controlled physiotherapy, weight loss and reduction of risk of reinjury.

If conservative management is elected, owners need to watch for deterioration of clinical signs which mean surgery is necessary. Pets are not allowed to stand on back legs. Exercise restriction is critical because if the patient is overactive, permanent paralysis can result. Bladder management is critical because bladder rupture or permanent disfunction can occur. Steroids are generally not used.

Success with conservative management is reported to be about 50% if deep pain is present. If deep pain sensation is absent, conservative management is generally associated with a very poor prognosis.

Recurrence generally occurs in about 10% of patients. It can be avoided at the previous disc rupture site by using fenestration of the affected site at the time of surgery. Recurrent disc ruptures carry no worse prognosis than initial ruptures and recurrence should not be an indication for euthanasia.

If surgery cannot be performed due to financial constraints, conservative management should be attempted because success rates of around 50% have been reported.

Angular Limb Deformities in Dachshunds

Background:
Angular limb deformity is the term used to describe a limb that is not "straight".
Angular limb deformities are usually the result of alterations in bone growth. In limbs with paired bones i.e. the forearm that has the radius and the ulna, Often one bone grows faster than the other resulting in an angular change.

Chondrodystrophy is an abnormality in cartilage development that results in altered bone growth/ development. This is a characteristic that has been selected/bred for in several dog breeds including Dachshunds and is the reason they have disproportionally short legs for their body size. The result of this genetic anomaly is the characteristic bendy legs of Dachshunds, Basset hounds, etc.

These anatomic characteristics of chondrodystrophic breeds (Dachsunds) mean that some of the angular limb deformity that we see is considered "normal". There is a point however, at which this characteristic conformation becomes pathologic (abnormal). At this point these changes can result in pain and disability.

It is also possible to see angular limb deformities in other dog breeds. In these cases the angular limb deformity is typically 'acquired' as a result of trauma to the cartilage growth plate while the animal is growing. This trauma causes the growth plate to stop growing and ultimately alters subsequent bone development.

Radius Curvus
In this lecture we are going to talk about angular changes in the front legs. Specifically, those that affect the antebrachium (forearm- radius and the ulna). This change is commonly called Radius Curvus and is a result of a growth disturbance in the bottom (distal) Ulna growth plate. This results in a situation where the radius is longer than the ulna and causes the following changes:

- External rotation of the paw
- Angular change of the paw (Valgus)
- Bowing of the radius (Procurvatum)
- An uneven surface in the elbow (incongruence)

These changes can vary in severity, in some cases they are mild and there is no lameness. In other cases the lameness is more severe and there are pronounced angulation changes in the foot. Interestingly although the changes in the wrist and foot look very abnormal, most of the pain comes from higher up the leg and is due to incongruence in the elbow. The incongruence results in

abnormal loading of the joints and ultimately causes osteoarthritis. It is for this reason that medical and surgical intervention is often sought. The aim of these treatments is to slow the progression of osteoarthritis and to improve lameness and pain.

Management of Radius Curvus

There are two approaches to treatment of angular limb deformities:

- Correction the deformity early before significant arthritis develops to improve limb alignment/ function and slow the progression of arthritis
- Provide symptomatic medical management to alleviate the pain associated with arthritis and possibly slow it's progression

Of course in many cases we do both!

Medical Management

- **Weight Reduction** - Obesity increases the weight that must be borne by the joints exacerbating pain associated with arthritis
- **Exercise Modification** - Reduction of high-impact activity reduces the cumulative force transmitted through the joint and alleviates pain associated with arthritis
- **EPA rich diet** - There is significant evidence that increasing the EPA (fatty acid) content of the diet has an anti-inflammatory effect in joints and reduces pain associated with arthritis
- **Non steroidal Anti-inflammatories (NSAIDs)** - NSAIDs are the cornerstone of medical management of arthritis and are very effective in controlling pain associated with arthritis. However they are not without potential side effects
- **Pentosan Injection** - There is some evidence that pentosan/cartrophen may alleviate pain and slow the progression of arthritis. The magnitude of effect is quite variable.
- **Stem Cells** - Stem cells appear to provide good pain relief in arthritic joints. This is still a relatively new therapy and there are still many questions regarding how they work, how long for and potential side effects

Surgical Management

The goal of surgical management is to improve the alignment of the limb and reduce the stress in the elbow joint. This will slow the progression of arthritis. Arthritis is irreversible once it has developed and so early intervention is key to optimizing the benefit of surgical correction. Accurate planning of angular limb deformity correction is very important in optimizing the postoperative outcome.

At Southpaws we utilize CT planning as well as 3D printing of a replica model of the bones. The 3D model allows us to implement the pre-operative plan on an exact replica of the dog's bones to confirm alignment of the limb is optimal before transferring this plan to the patient. At surgery the bones are cut and realigned to improve limb alignment. The bones are then stabilized with an external frame that holds the bones in their new position until they heal.

Postoperative care following a corrective surgery is very important and is usually required for 8 weeks following the surgery. This means no off leash activity for this period. This also means that your dog can't be allowed to jump on and off the couch. Generally the prognosis following surgery is very good. The level of lameness is often improved dramatically; the owners feel that the legs are straighter and that their dogs are happier. Remember that one of the big benefits from surgery, that is harder to quantify, is that the subsequent rate of development of osteoarthritis is likely slowed.