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Charly, a Patient With Lower Back Pain

Charly, a 2.5 year old German Shepherd cross, was referred to the Orthomanual Veterinary Clinic in Noorden because she had become unwilling to jump. Charly was diagnosed with lower back pain, caused by degenerative lumbosacral stenosis (DLSS). The dog was treated with orthomanipulation, followed by a managed mobility regime. In addition, gait assessments were performed with the use of a pressure plate. Two weeks after treatment the dog could walk very ably and was completely pain free in the lower back. Three months after treatment, her gaits had improved further, and Charly was able to jump without discomfort. Orthomanipulation thus appears to be an effective, non-invasive and economical treatment option for dogs with lower back pain.

Lower back pain

Lower back pain is a problem that is frequently seen in dogs with different conditions as the underlying cause. Degenerative lumbosacral stenosis (DLSS) is the most common cause. Over the years, different terms have been used for DLSS, such as lumbosacral instability, lumbosacral disc disease, lumbosacral stenosis, cauda equina syndrome and cauda equina compression (1). DLSS is mainly seen in large to medium-sized dogs, at about age seven. Additionally, DLSS is more commonly seen in males than in females, and there is a predisposition in the German Shepherd and working dogs (1-4).

DLSS is a multifactorial degenerative condition. Irregular mobility in the lumbosacral joint, caused by among other things (micro) trauma, repeated overexertion, and genetic and congenital defects, leads to degenerative changes of the L7-S1 disc. The onset of degeneration is associated with the breakdown of proteoglycans in the disc, which diminishes its

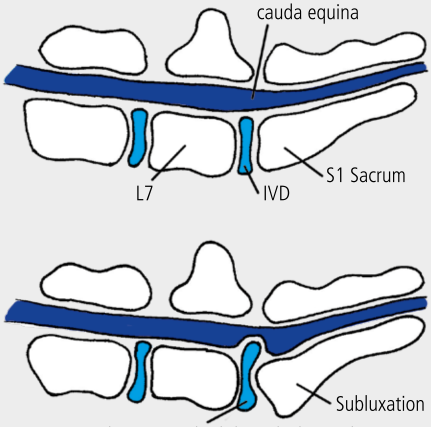

Figure 1: The pathophysiology of degenerative lumbosacral stenosis (DLSS): abnormal movement within the lumbosacral junction. This leads to degeneration of the intervertebral disc (IVD), which in turn causes vertebral instability and ventral subluxation of L7 or S1. This produces additional pressure on the intervertebral disc which can then lead to protrusion or extrusion. This causes proliferation of bone and soft tissue, which ultimately leads to compression of the cauda equina. This is expressed through pain and neurological dysfunction.

Table 1 Overview of nerve roots at the level of the cauda equina with their normal function and the findings suggestive of DLSS (1).

Nerve	Spinal cord segment	Reflex	Normal function	DLSS
N. Femoralis	L4-L6	Patellar reflex	Hip flexion Knee extension	Normal or pseudo-hyperreflexia
N. Ischiadicus	L6-S1	Tibialis cranialis reflex Gastrocnemius reflex Withdrawal reflex	Hip extension Knee flexion Extension and flexion of the tarsus Proprioception	Muscular atrophy Normal or hyporeflexia Normal or diminished postural reactions
N. Pelvicus	S1-S3		Emptying the bladder	Atony of bladder
N. Pudendus	S1-S3	Perineal reflex Anus reflex	Contraction of urethral sphincter Contraction of anal sphincter	Urinary incontinence Faeceal incontinence Normal or diminished perineal reflex
N. Caudalis	Cd1-Cd5		Tonicity of the tail	Normal or hypertonia

ability to absorb water and nutrients, causing it to slowly shrivel. These changes to the disc lead to increased instability of the lumbosacral joint, causing a thickening of the cartilaginous endplates which further restricts nutrient supply. The worsening instability can ultimately lead to subluxation of L7 or S1. Further, the shrivelling of the disc, combined with increasing pressure, can lead to IVDD (mainly Hansen type II).

To compensate for the instability, there is a proliferation of both bony and soft tissue elements. Stenosis of the spine and compression of the cauda equina can lead to lameness and neurological impairment. Furthermore, a secondary inflammatory response can cause vascular and neural in-growth in the damaged disc, leading to pain in the lumbosacral region (1-4).

The signs of DLSS can be acute or chronic, continuous or intermittent (5). The signs are more commonly orthopaedic than neurological in nature (1). They can consist of progressive pain in the hind quarters (lower back pain); hyperesthesia or self-mutilation of the lumbosacral region or hind legs; difficulty in rising, sitting or lying down; unwillingness to jump or go up or down stairs; unilateral or bilateral lameness; paresis of the hind quarters; muscular atrophy; a drooping tail; and/or urinary or faecal incontinence. Unilateral lameness or radiating pain is caused by entrapment of the nerve root at L7 and/or S1, causing the characteristic "root signature" posture. The signs are especially evident after activity (1-5).

The diagnosis DLSS is reached based on the patient history and clinical signs, in combination with findings from orthopaedic, neurological and orthomanual examinations. The diagnosis can be confirmed by diagnostic images.

Dogs with DLSS exhibit gait abnormalities. They bear less weight on their hind limbs, which can be observed in several ways: a roached back, placement of the hind legs under the belly and collapsing of the animal through the hind limbs. Affected animals may also exhibit pain upon palpation of the lumbosacral region, hyperextention of the tail, the hemipressure and/or lordosis test. Lameness can be worsened by pressure administered to the lumbosacral junction during hyperextention of the affected limb.

The neurological examination often reveals a problem of the LMN system, such as a normal or diminished withdrawal reflex or tibialis cranialis reflex, loss of postural reactions, a normal or impaired perineal reflex, normal or hypotonic tail tonicity or pseudo-hyperreflexia of the patellar reflex. Pseudo-hyperreflexia of the patellar reflex occurs because the muscular tonicity of the knee extensors (innervated by the N. Femoralis, not affected by DLSS) is greater than the muscular tonicity of the knee flexors.

Inspection during the orthomanual examination can show the pelvis to be tilted or that the heels are not level (at the same height). Upon palpation, a misalignment of the discs and/or the sacrum can be determined (6) (Figure 2 and 3).

For diagnostic images, an X-ray, CT or MRI can be performed. The following indications suggestive of DLSS can be seen on an X-ray: shrivelling of the disc, narrowing of intervertebral disc space, ventral subluxation of S1 leading to lumbosacral step formation, sclerosis of the vertebral endplates, spondylosis deformans, presence of transitional vertebra (these are vertebra characterized by unilateral or bilateral fusing of L7 with the sacrum or by separation between the first two sacral discs) and the so-called vacuum phenomenon. The vacuum phenomenon is a radiolucent area in the intervertebral disc space due to an accumulation of nitrogen (originating from the surrounding tissues) in a degenerated disc.

Alongside the problems visible on an X-ray, a CT may additionally show the following: a thickening of the ligamentum flavum, a thickening of the facet joint capsules, a narrowing of the lateral recesses, a narrowing of the intervertebral foramen and a HNP (primarily type II).

Figure 2: Orthomanual examination. Evaluation of the position and symmetry of the transversal processes of L5 on a skeleton.

On T2-weighted MRI images, the nucleus pulposus of the affected vertebra may exhibit lower signal intensity, due to dehydration. On T1-weighted MRI images, a disruption of the epidural fat can be found (1,3,7).

Treatment methods for lower back pain are conservative, i.e. a managed mobility regime, anti-inflammatory medications, pain relievers and (in some cases) weight loss; or surgical, i.e. dorsal laminectomy or fixation (1-3,5,7). Manual treatment methods, such as orthomanipulation, are often used in humans with back conditions, and orthomanual techniques have been applied in veterinary contexts for years (6,8).

Orthomanual veterinary medicine is a non-invasive, animal friendly treatment method focused on the symmetry of the skeleton and spine. Orthomanual treatment is based on the principle that a vertebral misalignment can cause pain, reduced mobility and loss of function. The objective of orthomanual treatment/orthomanipulation is to correct irregularities in disc alignment and in joints, to create favourable conditions for recovery and improvement of the neurological state (6).

Figure 3: Orthomanual examination. Evaluation of the position and symmetry of the transversal processes at the thoracolumbar junction in a dog.

Case description

Characteristics and symptoms

Charly, a 2.5 year old German Shepherd cross, female, sterilized, 21.4 kg, was referred to the Orthomanual Veterinary Clinic in Noorden with the complaint that she had become unwilling to jump into the car.

She had started limping three months earlier after running off chasing rabbits. A CT scan showed a slight narrowing of the intervertebral foramen on both sides and step formation in the lumbosacral region. Before her visit to the clinic in Noorden, she had received medication and use of the hind leg showed steady improvement, but she was still unwilling to jump into the car.

Clinical findings

Observation and gait assessment in walk and trot showed that Charly was limping on her left hind leg. The general clinical examination showed no irregularities. The orthopaedic and neurological examinations were performed in recumbent position,

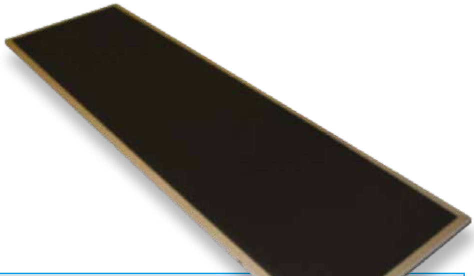

Figure 4: The pressure plate, which is a pressure sensitive walkway (1 m x 5 m) with which gait patterns can be objectively analysed (9,10).

on both the left and the right side. No irregularities in the joints were found. The muscle volume and tonicity of the front and hind limbs were normal. The spinal reflexes and proprioception were intact.

Orthomanual examination was performed on the back and neck while the animal was standing. The owner held the head steady, and an assistant supported the dog by placing both hands under her trunk, so she could stand stable and square. The spine was palpitated from tail to neck using both thumbs to exert light pressure on the transversal processes. At the same time, symmetry (or asymmetry), pain, muscular tone and muscular atrophy were evaluated by inspection and palpation. The dog expressed pain on palpation of the back at the level of the lumbosacral junction, and a vertebral misalignment was found at L7. No misalignments were found in the neck.

Treatment

Charly was treated with orthomanipulation: with the thumb light pressure was applied to the vertebral arch, followed by a light thrusting force against the spinous process, in order to restore the vertebra to its anatomically correct position. Typically, very little force is required to correct a misaligned vertebra, because the pressure is applied in the direction of the natural position and function (8).

A managed mobility regime was prescribed. The owner was advised to massage the muscles of the neck and the front and hind limbs prior to walks. In week 1 after treatment, 4 on-leash walks were allowed per day, 20 minutes per walk. In week 2, the 4 on-leash walks were increased to 25 minutes each, with further increases to 30 minutes in week 3 and 35 minutes in week 4. To strengthen the dog's hind limbs, the owner was encouraged to include gentle hills and/or bridges in the walks (starting with mild slopes and increasing steepness gradually over the four weeks).

After the first four weeks, the dog was allowed off leash, though here it was important for the dog to warm up first on the leash and be given ample time for cooling down afterwards. Swimming was allowed during the entire recovery period, if the dog enjoyed it.

Progression

At follow-up appointments, observations of the dog's locomotion were repeated, as were the orthopaedic, neurological and orthomanual examinations.

At the 2 week follow-up, Charly was walking very ably. The general, orthopaedic and neurological examinations revealed no irregularities. She was pain-free in the lower back area and the lower back remained stable. The owners were advised to continue the prescribed mobility regime.

At the three month follow-up appointment, Charly was walking fine. The general, orthopaedic and neurological examinations revealed no irregularities. She was pain-free in the lower back, which again remained stable, and the owner reported that for the past two months she could jump without discomfort (the owner was asked to continue the prescribed mobility regime for one month after the treatment). The orthomanual treatment was thereby successfully concluded.

Two weeks after the orthomanual treatment, a follow-up CT scan was performed to see if the clinical improvement could be correlated to changes on a CT scan. Despite the clinical improvements, no differences could be seen between the CT scan before the orthomanual treatment and the scan done two weeks after the orthomanual treatment.

The pressure plate

In the context of a research study, Charly's movement patterns were evaluated using a pressure plate before treatment, immediately following treatment, two weeks after treatment and three months after treatment (Figure 4). The owner led Charly over the pressure plate. The dog walked across the plate on a straight-line path at her chosen pace (an easy trot). This produced the following data (Figure 5, 6 and 7).

Before orthomanual treatment

The left hind leg was being loaded less than the right hind leg. Neither hind limbs rolled over completely, with the left hind being slightly worse than the right hind. Additionally, the loading of the hind quarters as a whole was somewhat diminished.

Immediately after orthomanual treatment

The left hind leg was being loaded slightly less than the right hind leg, but both hind limbs were being used with more strength than before treatment. The hind limbs were rolling over somewhat better, and loading of the hind quarters was a bit improved.

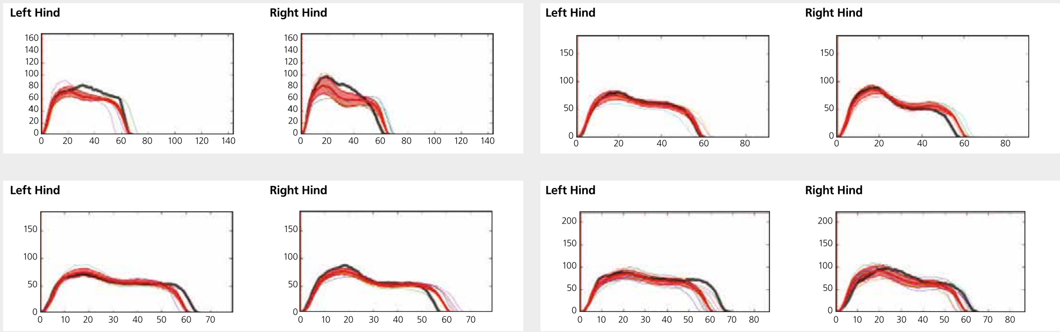

Figure 5: Graphs of Charly's hind limbs measured by pressure plate prior to treatment (top left), immediately after treatment (top right), two weeks after treatment (below left) and three months after treatment (below right). Plotted on the horizontal axis is time (125 is equivalent to 1 second) and the vertical axis represents force. The black line is the selected paw on the plate. The thin coloured lines represent the pressures of the other paws on the plate. The red line represents the average, with the red area being the standard deviation. From the graphs we see that at each data point, the left hind limb bears slightly less weight than the right hind limb. Further, the graphs exhibit an increasingly biphasic pattern. Such a biphasic pattern is seen in dogs with a "healthy locomotor apparatus", in which the dog first places more weight on the posterior part of the paw, then rolls over the paw, and then places weight on the front part of the paw before lifting the limb. Conclusion: Carly was rolling over her hind feet better.

Two weeks after orthomanual treatment

The left hind leg was being loaded more than before the treatment, and the right hind leg was being loaded a bit less than before treatment. The strength of the left hind leg was still somewhat less than that of the right hind leg, but the difference in the loading of the two was reduced. The hind limbs were rolling over well, with improved use of the hind quarters while walking.

Three months after orthomanual treatment

Both hind legs were being loaded more strongly than before treatment; with the left hind leg showing slightly less strength than the right hind. Both hind limbs were rolling over well, and the hind quarters was being used well/better when walking.

Conclusions

Over a three-month period, Charly exhibited substantial improvement, as determined by both clinical assessments and objectively measured using the pressure plate. Three months after treatment, Charly was walking very ably in clinical terms, and her back had remained stable. These clinical improvements were confirmed by findings from the pressure plate tests, which showed her hind limbs were striking the ground with more force. She was also rolling over her foot better, and used her hind limbs better when walking.

Discussion

The probable diagnosis of lower back pain due to DLSS is typically reached based on symptoms, the anamnesis, clinical signs and the clinical examination. To confirm a DLSS diagnosis, supplementary diagnostics are needed (X-ray, CT, MRI) (1,3,4,7). In view of the findings from the clinical examination and CT scan, lower back pain due to DLSS was the most likely diagnosis for this patient.

The typical age at which DLSS symptoms arise is about seven years (1,4). This does not correspond with the age that lower back pain symptoms manifest in this dog. This patient likely had lower back pain due to trauma sustained while chasing rabbits. German Shepherds and working dogs have a predisposition for DLSS (1-4), and this patient was a German Shepherd cross.

DLSS in dogs can be treated in various ways, depending on the patient's condition. Dogs with DLSS and pain as their only symptom are generally treated conservatively, with surgery reserved for patients that also exhibit neurological impairment. The aim of surgery is to eliminate compression of the cauda equina and nerve roots and to stabilize the lumbosacral joint (1-3,5,7). This patient had only pain, with no neurological impairment. The decision was made to treat the dog with orthomanipulation. Conservative treatment was also an option, but the owners decided against this. Surgery was not necessary, as the dog was not exhibiting neurological impairment (2).

In dogs with lower back pain/DLSS, orthomanipulation can be used to ease pressure on the vertebra and spinal cord, thus creating favourable conditions for recovery and improvement of the neurological state (6,8). The disc misalignment at L7 corresponds with the predispositional location for DLSS in dogs, that is between L7 and S1 (1).

The managed mobility regime subsequently prescribed is essential to give the body the rest needed for recovery and to prevent overexertion. The gradual increase of mobility helped the body regain its physiological function (11).

Currently, there is no generally accepted grading system for dogs with DLSS (2). Studies of the effectiveness of different treatment methods for DLSS evaluate treatment success based on clinical findings. In the study by De Decker et al. (2), 55% of the dogs examined were successfully treated with medication (2). Surgical treatment has a success rate of 66-96% (1,3,5,7). Regarding the success of orthomanual treatment of dogs with DLSS, no data are available, but orthomanipulation has been successfully applied for years (6). Due to the lack of uniformity in evaluations of treatment effectiveness, and because dogs treated with medication and surgery exhibit significantly different sets of symptoms, it is not possible to compare these treatment methods to each other (2).

Prior to treatment	**Left hind**	**Right hind**
Peak force (N*/cm²)	72.64 +/- 11.86	80.48 +/- 27.24
Peak surface (cm²)	23.58 +/- 1.56	25.72 +/- 3.82

Immediately after treatment	**Left hind**	**Right hind**
Peak force (N/cm²)	73.81 +/- 9.74	82.53 +/- 8.03
Peak surface (cm²)	23.89 +/- 1.65	26.13 +/- 1.08

2 weeks after treatment	**Left hind**	**Right hind**
Peak force (N/cm²)	74.01 +/- 5.74	78.85 +/- 8.07
Peak surface (cm²)	23.94 +/- 0.48	25.21 +/- 1.05

3 months after treatment	**Left hind**	**Right hind**
Peak force (N/cm²)	86.04 +/- 8.02	95.04 +/- 12.49
Peak surface (cm²)	24.28 +/- 1.06	24.92 +/- 1.48

Figure 6: Detailed data from Charly, measured by pressure plate prior to treatment, immediately after treatment, two weeks after treatment and three months after treatment. According to the data, the peak force (the strength with which a paw strikes the plate) increased gradually at each measurement point, and over the three months rose from 76 N/cm2 (on average) to 90 N/cm2. The peak surface (maximum contact area of the paw) remained more or less the same, but the difference between the left and right was virtually eliminated. Conclusion: Charly's hind legs were striking the plate with more strength and she was placing both her hind paws evenly on the plate (equivalent contact area). *N=Newton

Although this patient showed a complete clinical recovery, the improvement was not visible on the CT scan. Clinical findings do not always correspond to findings from diagnostic images, and furthermore, individuals' interpretations of diagnostic images can differ substantially (12). Suwankong et al. (13) demonstrated considerable agreement between findings from CT and MRI for dogs with DLSS, but found that findings from CT and/or MRI differ quite substantially from findings from surgery (13).

Many studies have been done using a force plate to assess the gaits of dogs both before and at three days, six weeks and six months after dorsal laminectomy. The conclusion from these studies is that the forward thrust of the hind legs is diminished in dogs with DLSS, and that dorsal laminectomy largely restores this forward thrust (14,15). We used a pressure plate to assess the gaits of our patient. Although the measured values from a force plate and pressure plate are largely different, a pressure plate can be used for the objective assessment of gaits in dogs (9,10).

	Prior to treatment
PT ratio peak force	58.70 +/- 20.16
PT ratio vertical impulse	65.86 +/- 26.74

	Immediately after treatment
PT ratio peak force	49.65 +/- 7.87
PT ratio vertical impulse	57.42 +/- 7.67

	2 weeks after treatment
PT ratio peak force	44.45 +/- 13.73
PT ratio vertical impulse	54.79 +/- 9.35

	3 months after treatment
PT ratio peak force	43.20 +/- 6.59
PT ratio vertical impulse	48.60 +/- 8.78

Figure 7: PT ratios for Charly prior to treatment, immediately after treatment, two weeks after treatment and three months after treatment. According to the data, the PT ratio peak force was lower at each measurement point, and over the three month period fell from 58.70 to 43.20. That means the hind limbs contributed more in walking. The PT ratio vertical impulse (surface area under the force-time graph) over the three month period fell from 65.86 to 48.60. That means the contact time and/or strength of the hind limbs increased relative to the forelimbs. Conclusion: Charly was using her hind quarters better and involving her hind limbs more in walking.

This patient exemplifies clinical recovery of a dog with DLSS following orthomanual treatment. Two weeks after treatment, the dog was walking very ably, and at the three month follow-up appointment, the owner reported that a month after the orthomanual treatment the dog could jump pain-free. The pressure plate showed that the dog's hind legs were striking the ground with more strength and rolled over better three months after the orthomanual treatment.

Orthomanual veterinary medicine therefore appears to be an effective, non-invasive treatment method for dogs with DLSS. The method is economical for the owner, and causes minimal stress to the patient (6). It is difficult to compare the effects of the different treatment options for DLSS in dogs. There is a need for clear definitions and uniformity in evaluations of treatment success.

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The research discussed here (studying the effect of ortho-manual treatment for degenerative lumbosacral stenosis) is still ongoing. You can help in this effort by referring dogs that have lower back pain for which orthopaedic problems have been ruled out (HD, arthrosis, etc.).