Far lateral lumbar disc extrusion in a dachshund dog

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Abstract: A 6-year-old Dachshund was presented with acute, non-localized pain without neurological dysfunction. Radiography revealed multiple calcifications of intervertebral discs and narrowing of disc space in the thoracolumbar region. Computed tomography and magnetic resonance imaging revealed calcified disc-like material entrapped in the left extraforaminal area and showed a displaced nerve root. Fenestration and removal of the extruded disc material were performed in a routine manner. Histopathological examination showed degenerative disc materials with severe calcification both in the nucleus pulposus and around the annulus fibrosis. Based on imaging, surgical, and histopathologic results, the dog was diagnosed with far lateral lumbar disc extrusion.

Keywords: far lateral lumbar disc extrusion, extraforaminal disc extrusion, disc calcification, IVDD, dogs

Intervertebral disc disease (IVDD) is the most common spinal and vertebral disorder in dogs [1]. There are 2 main types of IVDD: protrusion and extrusion. The protrusion type, also known as Hansen type II IVDD, is the result of fibroid degeneration, which induces thickening of the annulus fibrosis [2]. It is mainly observed in non-chondrodystrophic large-breed dogs, and progression of the disease is often chronic. In contrast, the extrusion type (Hansen type I IVDD) is more common in small, toy-breed dogs and is the result of chondroid degeneration, in which the gelatinous material in the nucleus pulposus is calcified producing reduced flexibility and compressibility, eventually resulting in sudden rupture of the disc [3]. Extrusion most commonly occurs in the thoracolumbar region, especially between T11 and L3 and is usually associated with acute clinical signs such as back pain, paraparesis, paraplegia, or urinary dysfunction [4]. Disc rupture can theoretically occur in any direction, but it mainly occurs dorsally due to the thinness of the annulus fibrosus [5]. In human medicine, disc extrusion is classified into 4 types depending on the rupture direction: central, lateral, foraminal, and far lateral (also known as extraforaminal) [6]. The majority of cases reported in dogs have focused on central and lateral IVDD, whereas there are few reports on foraminal and far lateral types. This case report describes a rare case of far lateral lumbar disc extrusion (FLLDE), also known as extraforaminal IVDD, in a dog. We believe that our case findings will considerably enrich the existing veterinary science associated with IVDD.

A 6-year-old male, castrated Dachshund dog, weighing 8 kg, was presented with acute, non-localized pain. The dog had a history of temporary limbic stiffness while running on the previous day; moreover, on the day of admission, he experienced discomfort in the left hindlimb. On physical examination, the dog exhibited severe back pain. Blood work, including a complete blood count and serum biochemistry analysis, showed no remarkable abnormalities. Neurological examination, including tests of cranial nerves, postural reactions, urination, and sensation, revealed no abnormalities.

Radiographs of thoracolumbar vertebrae were recorded in a routine manner (Titan 2000M; Comed Medical Systems, Korea). On the lateral projection, distinct calcified disc materials were identified between the 10th thoracic vertebra (T10) and T11, between T12 and T13, and between the first lumbar vertebra (L1) and L2 (Fig. 1). The intervertebral disc space between L1 and L2

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Conflict of Interest
The authors declare no conflicts of interest.

Received: March 26, 2019
Revised: June 11, 2019
Accepted: July 8, 2019
was distinctly narrowed, and a collapsed calcified disc was visible. Round, calcified, radiopaque material (5 mm in diameter) was seen on the ventrodorsal projection at the left side of the intervertebral disc space between L1 and L2.

Computed tomography (CT) was performed (BRIVO CT385; GE healthcare system, USA) in ventral recumbency using a pre-contrast bone algorithm with 100 kVp, 200 mAs, and 0.125 mm slice thickness without gantry tilting. In the transverse images, round-shaped hyperattenuating discoid material with a calcified rim was noted on the left side at the level of the intervertebral foramen between L1 and L2 (Fig. 2A). In the dorsal reconstructed CT images (Fig. 2B and C), some of the radiopaque material showed continuity with the vertebral canal. A round defect with a sclerotic bone margin was present in the central portion of the intervertebral disc. The remaining intervertebral disc showed multifocal calcifications on radiographs.

Magnetic resonance imaging (MRI) was performed under general anesthesia using a 1.5 Tesla system (Signa HDxt; GE healthcare system). Anesthesia was induced with propofol (6 mg/kg, IV; Provive 1%; Myungmoon Pharmaceutical Co., Korea) and was maintained with 1.5% isoflurane (Foran solution; Choongwae Pharma Corporation, Korea) in 100% oxygen via endotracheal intubation. The dog was positioned in dorsal recumbency on the 8-channel phased-array spine coil. The parameters of the MRI scan are summarized in Table 1.

On T2-weighted sagittal images, multiple thoracolumbar disc degenerations and dehydrations were visible (Fig. 3A). Although mild protrusions were detected multifocally, no evidence of spinal cord compression or myelopathy was observed. On the transverse plane, round hypointense material was identified on the left far lateral area between L1 and L2. A widening of space for nerve root fat was identified, implying entrapment of hypointense material in the space. There was no evidence of inflammatory changes around the vertebra, intervertebral disc, or paraspinal muscles. Based on the multimodal imaging results, the presence of extraforaminal calcified disc material, mineralized neurogenic tumor, and osseous vertebral tumor were considered indicative of

Table 1. Parameters of the magnetic resonance imaging sequences

<table>
<thead>
<tr>
<th>Parameters (unit)</th>
<th>T1W transverse</th>
<th>T1W sagittal</th>
<th>T2W transverse</th>
<th>T2W sagittal</th>
<th>T2W 3D Cube</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequence</td>
<td>FSE</td>
<td>FSE</td>
<td>FSE</td>
<td>FSE</td>
<td>3D-FSE</td>
</tr>
<tr>
<td>FOV (cm)</td>
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<td>25 × 25</td>
<td>12 × 12</td>
<td>25 × 25</td>
<td>16 × 16</td>
</tr>
<tr>
<td>Slice thickness (mm)</td>
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<td>3</td>
<td>1.5</td>
<td>3</td>
<td>1.6</td>
</tr>
<tr>
<td>Interslice gap (mm)</td>
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<td>3.3</td>
<td>1.8</td>
<td>3.3</td>
<td>2</td>
</tr>
<tr>
<td>Relaxation time (ms)</td>
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<td>532</td>
<td>5,008</td>
<td>3,500</td>
<td>2,600</td>
</tr>
<tr>
<td>Echo time (ms)</td>
<td>12</td>
<td>12</td>
<td>87</td>
<td>105</td>
<td>114</td>
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<tr>
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<td>352 × 224</td>
<td>288 × 224</td>
<td>352 × 256</td>
<td>256 × 256</td>
</tr>
<tr>
<td>Nex</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

T1W, T1-weight image; T2W, T2-weighted image; 3D, 3-dimensional; FSE, fast spin echo; FOV, field of view.
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Possible differential diagnoses.

Fenestration to relieve back pain was performed in a routine manner. The left side dorsolateral approach for fenestration was used in the intervertebral disc space between L1 and L2. By using a periosteal elevator, we elevated the epaxial muscles and exposed the articular facets. We retracted muscular attachments to the accessory process to expose the dorsolateral aspect of the annulus fibrosus. During the surgery, reddish irregularly shaped disc-like materials were detected; these were attached to the annulus fibrosus located below the articular process (Fig. 4A). The material was removed using a No. 10 blade and no evidence of bleeding was observed after removal. In the histopathological results, basophilic chondrocytes with multifocal calcification and chondroid degeneration were identified in cartilaginous material, features consistent with the intervertebral disc (Fig. 4B). The disc material showed no remarkable inflammatory and neoplastic changes. Severe calcification was observed in the nucleus pulposus and around the annulus fibrosus. The dog was finally diagnosed with FLLDE, a rare subtype of intervertebral disc extrusion.

The dog recovered after surgery without any events. Seven days after surgery, the neurological examination showed no remarkable findings and a complete loss of back pain. A month after discharge, physical and neurological examinations showed no abnormalities.

IVDD is the most common type of spinal cord disease in dogs. Traditionally, cases of IVDD are classified as either a Hansen type I extrusion or Hansen type II protrusion. [1] Protrusions are mainly chronic, while an extrusion type is more clinically significant because it is frequently accompanied by spinal cord injury due to acute disc rupture. [4] Disc extrusion usually occurs in the chondrodystrophic breeds and is associated with disc degeneration. In chondrodystrophic breeds, disc degeneration and calcification occur at a relatively young age and induce reduced flexibility and compressibility, which could result in acute disc rupture. [3] Because the dorsolateral aspect of annulus fibrosis is thinner than the ventral aspect in dogs, disc extrusion occurs mainly in the dorsal or dorsolateral direction [2]. Among the 4 types of disc extrusion mentioned above, the central and lateral types are occasionally grouped as paramedian disc extrusion.
sions, and in these cases, disc ruptures often occur in the dor-
sal direction in the vertebral canal. Foraminal and extrafor-
aminal disc extrusions are defined as the rupture of disc mate-
rial in an unusual direction and which mainly result in com-
pression of the nerve root rather than the spinal cord.

FLLDE accounts for only 4% of all disc herniation in
humans and occurs most commonly between L4–L5 or L3–
L4. The far lateral space, which includes the dorsal root gan-
glion, is defined as the area between the cranial articular
facet and the annulus fibrosus. Because the dorsal root gan-
glion contains a large number of neurons, compression by the
extruded disc material can cause various clinical symptoms.
Severe radiculopathy and acute non-specific pain could be
due to direct contact of the nucleus pulposus or annular frag-
ments with the dorsal root ganglion. Because of the small
size of the neural foramen, even small far-laterally herniated
disc fragments can produce severe symptoms. Since spinal
cord compression is less frequently encountered than typical
IVDD, paraparesis and paraplegia rarely occur. In the pres-
case, the dog displayed severe non-specific pain without
any abnormalities in gait or postural reactions, suspected to
be due to the radiculopathy.

Diagnosis of FLLDE is challenging, as the extraforaminal
zone is generally not visible on MRI in daily veterinary prac-
tice. According to the author's experience, a spinal MRI scan
is generally performed to initially produce a sagittal image in
which FLLDE may not be clearly visible. Therefore, spinal
cord compression may not be seen on a sagittal image, caus-
ing radiologists to possibly miss it. Even in humans, it is
reported that about one-third of FLLDEs are initially misdi-
agnosed, often as a retroperitoneal mass, metastatic tumor, or
peripheral nerve sheath tumor [7-9]. In the case of multiple
IVDD, FLLDE can be overlooked and other aspects can be
diagnosed as the main cause; this leads to a poor prognosis
due to delayed diagnosis. To minimize such misdiagnosis, it
is important to confirm the symmetricity of the annulus
fibrosis on the transverse plane, because most FLLDEs attach
to the annulus fibrous producing a distortion of the disc con-
tour [6,10]. In contrast to that in humans, the spinal nerve is
too small to be clearly visible in dogs; thus, on MRI, fat sup-
pression sequences may be helpful to identify inflammatory
reactions around the nerve root, caused by extruded disc
material. In general, CT is not the gold standard procedure
for diagnosing and evaluating disc extrusion in dogs, but it
was very useful in the present case for diagnosing FLLDE
because it showed a wide range of anatomical structures and
multiplanar reconstructions. On the CT scan, the extraforam-
inal disc material has continuity into the vertebral canal on
the dorsal reconstructed images, suggesting that the extrafo-
raminal mass may be extruded disc material. As in the pres-
cent case, a previously reported dog had calcified disc
material in the extraforaminal zone [11]; therefore, CT
is expected to play a complementary role, with MRI, in the
diagnosis of FLLDE.

In human medicine, various prognoses of FLLDE have
been reported. Since FLLDE does not directly compress the
spinal cord, the post-operative prognosis is good [8]. How-
ever, FLLDE can be easily overlooked on MRI examination,
and the prognosis could be worse than typical IVDD because
of the associated difficulty in diagnosis. In addition, FLLDE
generally occurs in older groups that have concurrent degen-
erative changes such as lumbosacral stenosis, leading to a
poor prognosis in human [10]. However, IVDD occurs at a
relatively young age in chondrodystrophic dog breeds in
which concomitant degenerative changes are expected to be
relatively rare. Although multiple disc degeneration was
clearly identified in situ, no additional degenerative changes
were observed in the present case.

A case of FLLDE is very rare and, to our best knowledge,
only one case report has been previously published in veteri-
nary medicine [11]. Prognosis of that case was excellent, and
the authors believed that if the diagnosis of FLLDE is made
accurately in a short time, the prognosis is expected to be
better than that of typical IVDD. In fact, in the present and
the previous case, the dog recovered immediately after the
surgery with back pain signs completely disappeared. In
human medicine, all 19 patients diagnosed with FLLDE
showed excellent prognosis and loss of leg pain following
surgery [12]. Another study reported that 71% of patients
diagnosed with FLLDE improved with conservative treat-
ment [8]. Though in the present case surgical removal was
performed to relieve severe back pain, further investigations
regarding the prognosis and treatment of FLLDE in dogs are
necessary.

Calcification of intervertebral discs is frequently observed
on radiographs of chondrodystrophic breeds, especially
Dachshunds. Based on the previous study [11], the calcified
discs are degenerative changes; it is also known that the
greater the calcification, the more likely that disc rupture will
occur. Also, as the number of affected discs increases, dogs
become more predisposed to IVDD and disc rupture [13]. In
the present case, the calcified disc material in the extrafo-
raminal area is considered to be related to severe calcification
and the possibility of sudden rupture of the intervertebral
disc. A degenerative, calcified nucleus pulposus can herniate
from mild trauma and exercise in humans, and in the present
case, the calcified nucleus pulposus may have migrated trans-
foraminally due to exercise [14]. Hence, chondrodystrophic
breed dogs, whose radiographs frequently display calcified
intervertebral discs, could be predisposed to FLLDE; this
knowledge is necessary when educating owners of these
breeds about the potential need for exercise restriction.

This case report described a case of FLLDE with a rare man-
ifestation of intervertebral disc extrusion. Because definite spi-
nal cord compression may not be seen on a sagittal image,
careful interpretations should be performed to avoid misdiagno-
sis as neurogenic or metastatic tumors. When a chondrodystro-
phic breed dog (such as a Dachshund) shows disc calcification,
decreased intervertebral disc volume, and severe back pain,
FLLDE should be considered as a differential diagnosis.
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References