

Far Lateral Intervertebral Disc Extrusion (IVDE) in a Dog: Sequestrectomy as a Potential Surgical Option

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ABSTRACT

Background: Far lateral intervertebral disc extrusion (IVDE) is rare and poses diagnostic and therapeutic challenges in veterinary medicine. Although surgical techniques such as hemilaminectomy are widely used, they often require bone drilling, which may increase the risk of spinal instability and prolong operative time. In human medicine, sequestrectomy - removal of only the extruded disc without bone drilling - has demonstrated favorable outcomes in terms of recovery and pain management. However, this technique has not been previously reported or evaluated in veterinary patients. This case report introduces sequestrectomy for far lateral IVDE in a dog and describes its clinical outcome.

Case: A 9-year-old, male castrated Coton de Tulear (chondrodystrophic dog breed) presented with a 5-month history of right hindlimb lameness and a prior history of cervical IVDD. Neurological examination revealed severe pain on palpation of the right L6-L7 region, with no other neurological deficits. Radiographs and computed tomography (CT) demonstrated calcified intervertebral discs and far lateral extrusion at L6-L7. Magnetic resonance imaging (MRI) confirmed nerve root compression by the extruded disc, without spinal cord compression. Conservative management with gabapentin and methocarbamol for 2 weeks was unsuccessful. Surgical intervention was performed using sequestrectomy, as spinal cord compression was absent on imaging and nerve root compression was isolated, whereby the extruded disc material was removed without bone drilling to preserve segmental stability and minimize operative trauma. The patient showed immediate postoperative neurological improvement, standing on the day of surgery with minimal pain response, and regaining full weight-bearing within 2 days. Postoperative imaging confirmed removal of the compressive disc material, although mild recurrence was observed without neurological deficits. The patient remained pain-free and exhibited continued functional recovery during follow-up.

Discussion: This case report is the 1st in veterinary medicine to employ the term "sequestrectomy" and to detail its clinical outcome for the treatment of far lateral IVDE. Conventional surgical options in veterinary practice frequently require partial vertebral resection for decompression, increasing spinal instability, prolonging operative time, and elevating the risk of spinal cord injury; in contrast, sequestrectomy avoids bone drilling and thereby reduces these risks. Although recurrence of disc extrusion remains a concern, human studies have shown comparable recurrence rates between sequestrectomy and conventional discectomy, with superior outcomes in pain and recovery. Furthermore, sequestrectomy preserves the possibility of revision surgery if needed. In this case, patient selection was based on isolated nerve root compression without spinal cord compression and a far lateral fragment that was accessible via a bone-sparing approach. Postoperatively, the patient showed prompt neurological improvement, minimal pain response, and rapid return to full weight-bearing, with objective gait analysis corroborating functional gains. The successful application of sequestrectomy in this case suggests that it may be a valuable surgical option for select cases of IVDE in veterinary medicine. Future studies are warranted to further evaluate the prognosis and long-term outcomes of this technique, particularly in combination with advanced surgical tools.

Keywords: Canine, Chondrodystrophic breed, IVDE, discectomy, far lateral extrusion.

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INTRODUCTION

Intervertebral disc extrusion (IVDE) can lead to compression of the spinal cord or nerve roots, causing neurological deficits and pain. As in this case, chondrodystrophic breeds are predisposed to IVDE from early fibroblast growth factor 4(FGF4) - related disc degeneration; ongoing studies address its causes and diagnosis [3,6,15].

In humans, IVDE is classified into 4 types based on the direction of disc extrusion: central, lateral, pedicle, and far lateral [9]. Far lateral extrusion is underreported in veterinary medicine, partly due to diagnostic challenges. Despite growing interest, most studies still focus on diagnosis [2,4,8,10,13].

Treatment of spinal cord and nerve root compression caused by IVDE includes conservative and surgical approaches. Conservative treatment provides satisfactory outcomes in most IVDE cases. Surgical intervention should be considered if conservative treatment fails. The surgical treatments for IVDE include hemilaminectomy, dorsal laminectomy, pediculectomy, fenestration, or a combination of these [11]. All surgical methods involve procedures requiring bone drilling or discectomy.

In human medicine, sequestrectomy is used, which involves the removal of the extruded disc without bone drilling or discectomy. This surgical procedure has shown better outcomes in terms of recovery time and pain management than conventional discectomy [7, 12]. The purpose of this report was to introduce the use of sequestrectomy for the treatment of far lateral IVDE in veterinary medicine and discuss its prognosis. We believe that this study will be of interest among veterinary surgeons regarding the application of sequestrectomy in veterinary medicine.

CASE

A 9-year-old male castrated Coton de Tulear dog, weighing 3.5 kg, was referred to the Kangwon National University Veterinary Medical Teaching Hospital with right hindlimb lameness. The patient had shown signs of lameness for 5 months and had a history of cervical IVDD treated with conservative management 4 years earlier.

Physical examination revealed atrophy of the right thigh muscle, and gait analysis revealed skipping lameness in the right hindlimb during

walking. Pressure sensor gait analysis¹ indicated significantly lower weight-bearing on the right hindlimb than on the contralateral side.

Orthopedic and neurological examinations were conducted to identify the cause of hindlimb lameness. The orthopedic examination revealed no abnormalities. The neurological examination revealed severe pain on palpation of the L6-L7 area on the right side. The other spinal reflexes, cranial nerves, and postural reactions were normal.

Narrowing of the intervertebral space between C5-C7 and calcified intervertebral discs throughout the vertebral column were observed on radiographs. Subsequently, computed tomography (CT)² was performed. The CT scan revealed calcified intervertebral discs in the vertebral column and disc extrusion with calcification in the L6-L7 intervertebral space (Figure 1A & C). The 3D reconstruction images also revealed an extruded disc with calcification at the L6-L7 intervertebral foramen (Figure 2A & C). Magnetic resonance imaging (MRI)² was performed. T2-weighted MRI examination identified the nerve root compressed by the extruded disc near the L6-L7 intervertebral foramen (Figure 1E).

Based on the diagnostic examinations, the cause of the lameness was diagnosed as nerve root compression due to the extruded disc. Medical treatment was initially administered for 2 weeks. Gabapentin³ [10 mg/kg, PO, TID] and methocarbamol⁴ [15 mg/kg, PO, TID] were prescribed for 2 weeks, and cage rest was implemented. However, the lameness and pain showed no improvement after 2 weeks of medical treatment, and surgery was decided upon.

For premedication, butorphanol⁴ [0.2 mg/kg, IV] and midazolam⁵ [0.2 mg/kg, IV] were administered intravenously, followed by induction with propofol⁶ [5 mg/kg, IV]. Endotracheal intubation was performed with anesthesia maintained using isoflurane⁵. Fentanyl-Lidocaine-Ketamine (FLK) was used to control pain. Cefazolin⁷ [22 mg/kg, IV] was administered intravenously at the incision site and every 60 min thereafter. The surgical field was sterilized using Iodine povacrylex (0.7% available iodine) and isopropyl alcohol (74% w/w) [DuraPrepTM Surgical Solution]⁸ and covered with iodophor impregnated drape [IobanTM]⁸. The

location was confirmed under fluoroscopy⁹, and an incision was made from the cranial border of L5 to the caudal border of L7. After the skin incision, the thoracolumbar fascia was dissected, and access was achieved between the transversospinalis muscles and longissimus lumborum muscle. Muscles attached to the facet were removed to create a clear view of the surgical field. The L7 intervertebral foramen was exposed; without bone drilling, all the visible disc material was removed using a probe and curette (Figure 3). The spinal canal was then probed to confirm the absence of remaining disc material, and the muscles, fascia, and skin were routinely sutured.

The patient was able to stand immediately after awakening from anesthesia but was hospitalized for stabilization. During hospitalization, the following medications were administered: meloxicam¹⁰ [loading dose 0.2 mg/kg IV on day 1; maintenance 0.1 mg/kg IV, SID from day 2] as an anti-inflammatory and pain relief medication, gabapentin [10 mg/kg, PO, TID] for neuropathic pain, methocarbamol [15 mg/kg, PO, TID] as a muscle relaxant, and cefazolin [22 mg/kg, IV, TID] as a prophylactic antibiotic. The pressure sensor gait analysis was conducted on postoperative day 2, and the symmetry index and weight distribution of the right hindlimb showed significantly better results compared to the preoperative measurements

($P < 0.01$) [Figure 4]. Postoperative CT and MRI confirmed the removal of the disc material that had been compressing the L6 nerve root; however, disc material was observed in the L6-L7 spinal canal (Figure 1B, D & F). The intraoperative probing had confirmed that no disc material remained in the spinal canal after removal; therefore, the disc material observed on the CT and MRI images was determined to be due to recurrence. CT reconstruction also confirmed the disappearance of the disc material that had been compressing the nerve root; however, some disc material was still observed in the spinal canal (Figure 2B & D). The patient was discharged, meloxicam was discontinued, and other medications were administered orally for 1 week. Exercise was restricted to room rest and leash walking for up to 15 min daily for 1 month. Passive range of motion (PROM) exercises and massage were performed twice daily during home care.

At the 1-week postoperative follow-up, palpation of the L6-L7 area revealed no pain or neurological deficits. Pressure sensor gait analysis showed that weight-bearing in the right hindlimb was maintained at the same level as that on the 2nd postoperative day. In addition, pressure sensor gait analysis revealed continuous recovery during the follow-up visits at postoperative weeks 2 and 6 (Figure 4). By postoperative week 6, the muscle mass had become equal to that of the contralateral limb.

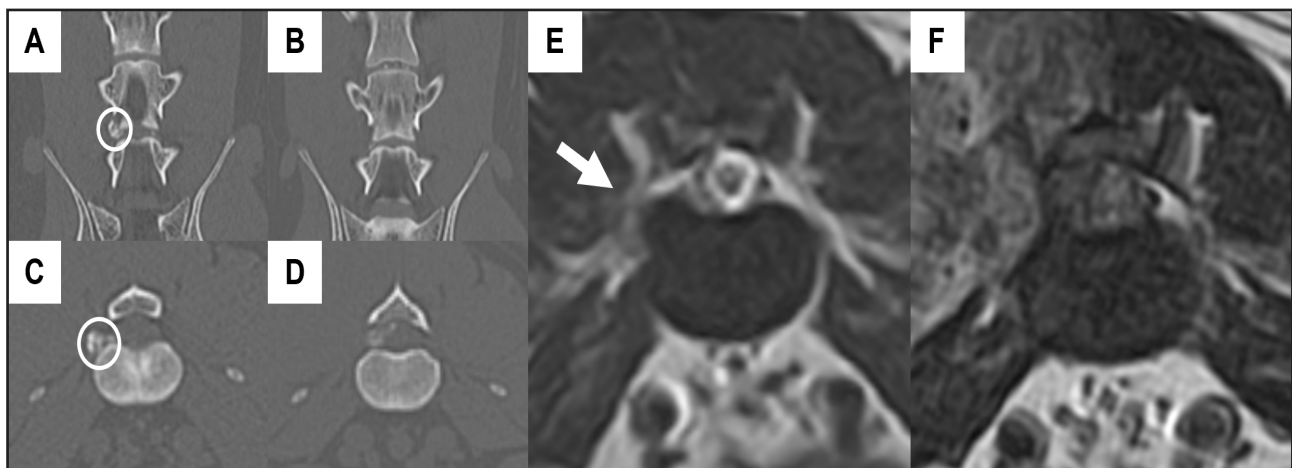


Figure 1. Images of preoperative computed tomography (CT) and magnetic resonance imaging (MRI). A & C- Preoperative CT images of the L6-L7 intervertebral disc space show a calcified extruded disc (white circle). B & D- Postoperative CT images of the L6-L7 intervertebral disc space show that the disc material has been removed. D- Recurrent disc material is visible in the spinal canal. E- Preoperative T2-weighted transverse image shows compression of the L6 nerve root caused by the extruded disc. F- Postoperative T2-weighted transverse image shows that the nerve root compression has been relieved after the removal of the disc material.

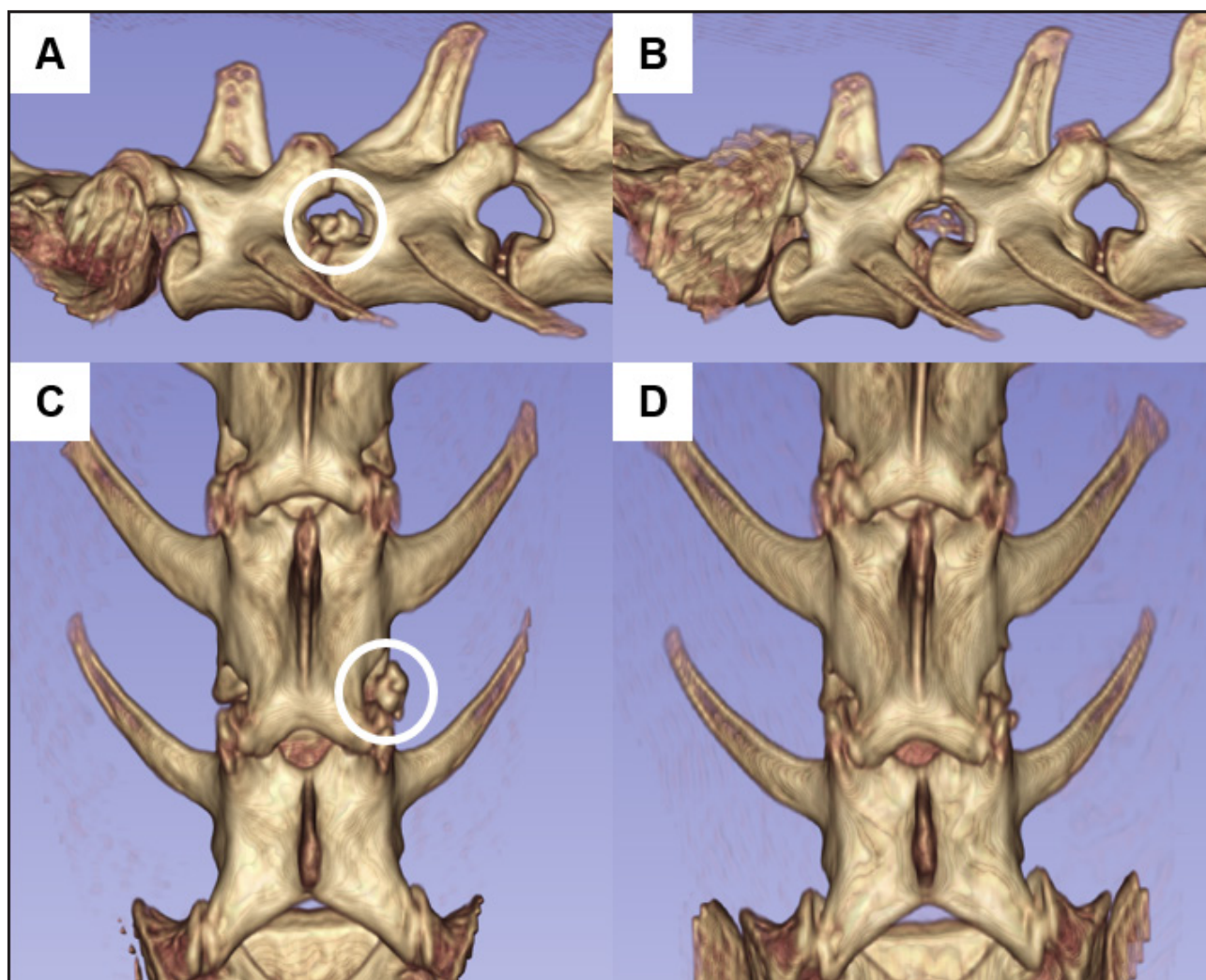


Figure 2. A & C- Preoperative; and B & D- postoperative CT reconstruction images. A & C- Calcified extruded disc material is visible (white circle). B & D- The extruded disc material has been removed.

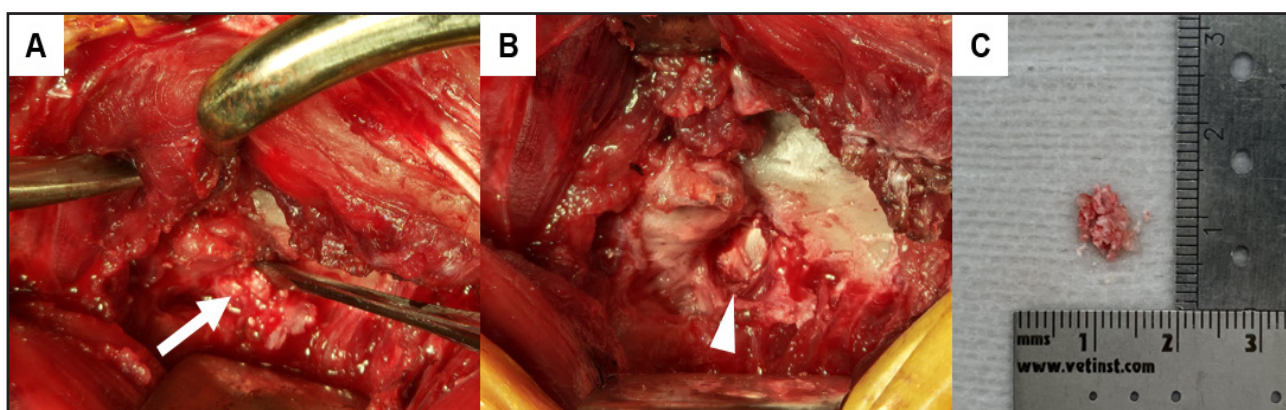


Figure 3. Intraoperative images (A & B) and removed disc material (C). A- Image showing the removal of disc material protruding outside the foramen using a curette (white arrow). B- Image showing that all extruded disc material has been removed (white arrowhead), without the need for bone drilling or discectomy. C- The removed disc material.

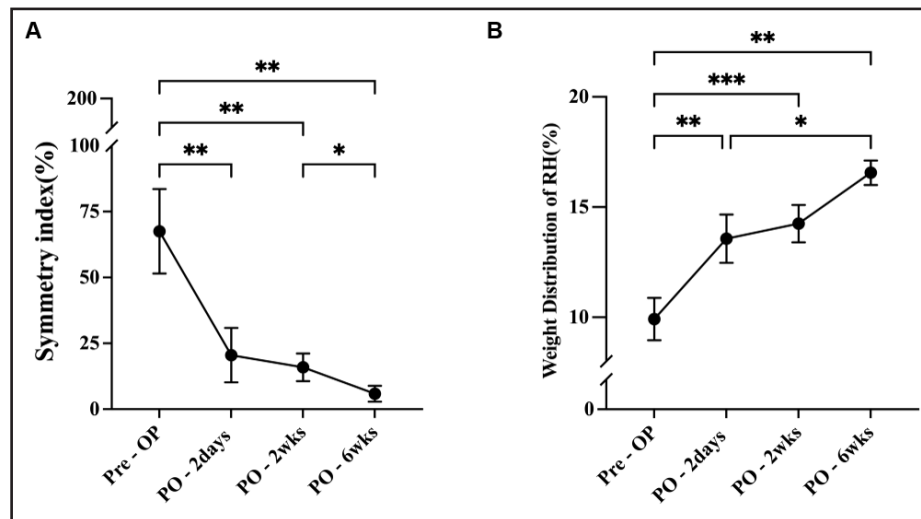


Figure 4. Gait analysis using a pressure sensor walkway. A- Hindlimb symmetry index; and B- Weight distribution of 4 limbs preoperatively and at postoperative day 2, week 2, and week 6. A- The symmetry index (SI) of the hindlimbs shows a dramatic improvement compared to the preoperative state (* $P < 0.05$; ** $P < 0.01$). B- The weight distribution of the right hindlimb shows improvement compared to the preoperative state (* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$). Pre - OP: preoperative; PO - 2 days: postoperative day 2; PO - 2 wks: postoperative week 2; PO - 6 wks: postoperative week 6; RH: right hindlimb.

DISCUSSION

As in this case, chondrodystrophic breeds commonly develop IVDE, and consensus guidelines on management exist [11]. IVDE may lead to nerve root compression alone, as in the present case; spinal cord compression; or both. Patients with nerve root compression alone may exhibit lameness without neurological deficits [2]. In such cases, differentiation from orthopedic disorders through orthopedic and neurological examinations is essential. Treatment of IVDE generally includes medical or surgical approaches. However, in cases of far lateral extrusion such as this one, there are few studies on the prognosis of conservative treatment in dogs. In this case, surgery was performed because symptoms had not improved after 2 weeks of medical treatment.

Surgical treatment offers various options; however, in veterinary medicine, most treatments involve partial removal of the vertebra. While these procedures allow reliable decompression, they carry risks, such as increased spinal instability, longer operative times, and potential spinal cord damage. While discectomy is increasingly used for the removal of disc material, they require skill to be performed safely. Potential complications include additional extrusion, vertebral instability, secondary neuromuscular complications due to damage

to peripheral nerves or nerve roots, hemorrhage, and the development of spondylosis deformans [11].

Sequestrectomy, a procedure that focuses solely on removing extruded disc material, addresses several limitations of traditional procedures, such as increased spinal instability and prolonged operative times. Although concerns exist about recurrence due to remaining disc material, human studies have shown no significant difference in recurrence rates between discectomy and disc extrusion removal alone. In fact, sequestrectomy has shown superior outcomes in terms of pain and recovery times compared to conventional procedures [1,12,14]. One study reported that sequestrectomy had a higher recurrence rate of disc extrusion but resulted in higher patient satisfaction and better outcomes in terms of recovery time and pain management [7]. Additionally, sequestrectomy has the advantage that, in the event of complications such as recurrence, revision surgery options such as hemilaminectomy remain available. The ability to perform less invasive surgical procedures as revision options can be a significant benefit for pet owners and veterinarians.

In this case, surgical procedures such as hemilaminectomy or foraminotomy were deemed unnecessary for decompression because the extruded disc material did not directly compress the spinal cord. Additionally, fenestration was not performed because

fenestration at the caudal side of L4–L5 may increase morbidity [5,16]. Therefore, only the disc material was removed via sequestrectomy, with dramatic results. The patient was able to stand on the day of surgery, achieved full weight-bearing in 2 days, and was pain-free on palpation and manipulation at postoperative week 1. Postoperative MRI revealed a mildly recurrent disc without neurological deficits. Pre- and postoperative CT reconstructions clearly showed the removal of the calcified disc material.

This report discusses the dramatic effects of sequestrectomy. Although there have been studies in veterinary medicine that mention a surgical technique similar to that used in this case, none have described the outcomes of this approach. This case report is the 1st in veterinary medicine to use the term "sequestrectomy" and to provide a detailed description of its clinical outcome [13]. Theoretically, this procedure offers advantages over traditional methods in terms of spinal stability, surgical time, pain, and recovery period. The use of sequestrectomy with advanced tools such as microscopes and endoscopy is expected to further enhance these benefits. Therefore, to establish this surgical technique, future studies based on

this case, along with research on its combination with advanced devices, are needed to determine the prognosis of sequestrectomy. Based on these findings, we could establish another powerful surgical option for the treatment of disc extrusion.

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