Chronic intervertebral disk herniation associated with fused vertebrae treated by vertebral lateral corpectomy in a cat

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Summary
A 10-year-old Domestic Shorthair cat was admitted for chronic ambulatory paraparesis and a spinal malformation. The clinical examination revealed paraparesis accentuated on the left side. Thoracolumbar radiographs revealed a spinal malformation with a narrowed intervertebral space between L1 and L2, and a dorsal fusion at the level of L2-L3 with a common dorsal process. Magnetic resonance imaging (MRI) revealed an intervertebral disk herniation with a ventral compression of the spinal cord at the level of L1/2. A standard vertebral lateral corpectomy with a foraminotomy was performed with a good outcome.

Keywords
Corpectomy, cat, chronic disk protrusion

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Introduction
Intervertebral disk herniation is a common finding at necropsy in cats (1–4). However, few cats show clinical signs of spinal cord disease secondary to intervertebral disk herniation, and these are generally limited to geriatric cats over 15 years of age (1–3). There are only sporadic case reports of cats with clinical signs because of a chronic Hansen Type I thoracolumbar disk extrusion (5–12). The incidence of intervertebral disk disease in cats is reported to be 0.12%, which is much lower than in dogs, and clinical signs appear to occur more frequently with disk extrusion than with disk protrusion (11). There are few reports of surgical decompression in cats with thoracolumbar disk extrusion (5–12). To the authors knowledge, this is the first case in which a vertebral corpectomy was performed in a cat with a history of chronic intervertebral disk herniation.

Case report
A 10-year-old, spayed female domestic shorthair cat was referred for evaluation of an abnormal hind limb gait with a slow onset of clinical signs and progressively getting worse over a five month duration. Neither fecal nor urinary incontinence had been observed. The cat had been treated by the referring veterinarian with Prednisolon Streuli tablets (Streuli Pharma AG, Uznach Switzerland, 0.5 mg/kg PO q12h) for 10 days with minimal to no improvement. The cat was an indoor/outdoor pet that had been regularly vaccinated against feline leukemia and panleukopenia virus, and did not have a history of trauma.

A neurological examination revealed ambulatory paraparesis, accentuated on the left side. Postural reactions were decreased, and the patellar, cranial tibial and flexor withdrawal reflexes were increased in both hind limbs with more pronounced deficits on the left side. On spinal palpation, hyperalgesia was noted at the region L1-L2. The clinical examination was otherwise unremarkable. Based on these findings, the anatomical localisation was in the thoracolumbar region (T3-L3). Differential diagnoses included: a space-occupying lesion, such as neoplasia lymphoid or non-lymphoid like meningioma or osteosarcoma or a herniated disk, as well as trauma, fibrocartilaginous embolism, and infectious or inflammatory diseases.

A complete blood count (CBC) and serum biochemistry profile did not reveal any abnormalities, and serological tests for FeLV and FIV were negative. General anesthesia was performed for diagnostic imaging. The patient was sedated with diazepam\(^a\) (0.02 mg/kg BW IV) and fentanyl\(^c\) (5 μg/kg BW IV) and anesthesia was induced with propofol\(^d\) (2 mg/kg BW IV). The cat was intubated and provided with 100% oxygen and anesthesia was maintained with a fentanyl drip (Janssen, Neuss, Germany, 2008).
5–10 µg/kg/h IV) and isoflurane (1.5–2 %), which was adjusted on the basis of anesthetic depth.

Radiographs of the lumbar spine showed a dorsal fusion at the level of L2 and L3 with a common dorsal process and a partially preserved intervertebral space. The axis of the spine was deviated in lordosis. The vertebral canal was enlarged in the region of L2-L3 and there was a generalized mild reduction in bone density of the vertebral bodies L2 and L3. The intervertebral spaces between L1–2 and L3–4 were narrowed compared to the adjacent spaces (Fig. 1).

A magnetic resonance imaging (MRI) examination, using a low-field MRI unit (0.3T, Hitachi Airis II), was performed during the same general anesthesia. The cat was positioned in dorsal recumbency with the body placed in a human head coil. Sequences included a sagittal and transverse T2-weighted fast spin echo (FSE), a transverse T1-weighted spin echo (SE), a dorsal fat suppressing STIR sequence and a dorsal T1-weighted high-resolution gradient echo (FE 3D MPR). The slice thickness ranged from 2.5 to 3 mm in the standard sequence and was 1 mm in the FE 3D MPR. The intervertebral disk between L2-L3 was profoundly thinned and incompletely separated the vertebral bodies. Both vertebral bodies showed a deviation of the axis ventrally. The processus spinosus of L2 was thickened and fused to the spinal process L3. The vertebral disk of L1/2 was extruded dorsally with emphasis to the left side. The spinal cord was dorsally deviated and considerably dorsally flattened. At the level of the compression, the signal intensity of the spinal cord was slightly increased in T2. Another, less severe, median herniation was present between L4/5. The disk material was in contact with the spinal cord; the spinal disk was deviated dorsally but only slightly flattened. From L1 to L5, all of the intervertebral disks showed decreased signal intensity in the T2-weighted sequences (Figs. 2A-C).

Surgery was performed immediately following diagnostic imaging. Anesthesia was continued with a fentanyl drip (5 µg/kg/h intravenously [IV]) and isoflurane (1.5–2 %) in oxygen. Lactated Ringer’s solution (10 ml/kg/h IV) was administered throughout surgery. Cefazolin® (25 mg/kg IV) was administered immediately before induction and again at the end of surgery. Monitoring included electrocardiography and end-tidal C02 concentrations.

A foraminotomy with a corpectomy was performed at the level of L1/2. The surgical approach was performed from the left side. The cat was positioned in slightly oblique sternal recumbency so that the side with the extruded disk material was facing upwards. The skin incision was 1 cm lateral to the midline on the side of the lesion, extending at least one vertebra cranial and caudal to the intervertebral space to be approached. The fascia on the lesion side was opened in a paramedian fashion. The multifidus muscles were elevated from the spinous processes and the vertebral arch, and retracted to expose the articular process and longissimus tendon attached to the accessory process. The longissimus tendon was cut at its insertion to expose the intervertebral foramen ventrally. The vertebra was prepared surgically so that the lateral aspect of the annulus fibrosus and the lateral aspect of the adjacent vertebral bodies were visible. The intervertebral artery and the nerve root were identified and preserved. Muscle retraction was maintained with 2 Gelpi retractors. Bleeding vessels were meticulously coagulated with bipolar electrocautery. A corpectomy was performed with the foraminotomy. A lateral slot was created with a high-speed pneumatic drill (Minos, 3M, Neuss, Germany) in the centre of the intervertebral disk space (Fig. 3). The amount of bone to be removed was determined by the MRI, which indicated the extension of compression of the disk herniation. The landmarks for the slot were 1/4 cranial vertebral body length for the caudal margin, 1/4 cranial vertebral body length for the cranial margin, and 1/2 vertebral body height for the ventral margin (13). The drilling was performed above the ventral margin and was extended dorsally until the floor of the vertebral canal was reached. The protruding disk annulus was retracted to the level of the intended slot. When there was no further material to be removed, the excision of the protruded disk was considered to be complete. As far as the foraminotomy allowed visualization of the spinal cord, this appeared grossly unremarkable. The removed disk material appeared to be dense in composition, and was not submitted for further histopathological examination.

Copious lavage was performed with isotonic saline (0.9% NaCl) at room temperature before closure. The dorsolumbar fascia, the subdermal fat tissue and the subcutaneous tissues were apposed with 4–0 polydioxanone, and the skin with 4–0 polypropylene.

The cat made an uneventful recovery from anesthesia. Postoperative analgesia was provided with fentanyl® (5–10 µg/kg/h IV) for 24 hours, followed by buprenorphine® (0.015 mg/kg SC q8h for three days) and carprofen® (2 mg/kg PO q24h for six days). Physiotherapy was initiated three days after surgery.

Twenty-four hours after surgery, the cat was neurologically unchanged. The patient showed an ambulatory paraparesis with decreased postural reactions and increased pa-

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Forene®, Abbott, Wiesbaden, Germany.
Kezrol®, Teva Pharma, Aesch, Switzerland.
Rimadyl®, Pfizer, Zurich, Switzerland.
Temgesic®, Essex, Munich, Germany.
tellar, cranial tibial and flexor withdraw reflexes in both hind limbs. A slight subjective neurologic improvement was observed over the first four days after surgery, but the cat remained paraparetic. On day six, the cat was in good general condition and was eating with a good appetite. The patient was discharged from the hospital without further medication but with instructions for continued home physiotherapy.

On follow-up examination six months after surgery, the cat was walking with a normal gait and neither clinical nor neurologic abnormalities were detected.

Discussion

Block vertebrae are the result of failure of segmentation in the developing embryo and have not been described as a sequel to spinal trauma, if the x-ray does not show any signs of reactive bone proliferation (14–16). The malformation may occur at any point along the spine and may involve part, or all, of a vertebra. Although block vertebrae are occasionally described as incidental radiographic findings, only one previous report of a cat with a block vertebra and the associated clinical problems exists (17). Pain and neurological deficits secondary to neural compression may result from stenotic block vertebra, spinal angulation or instability (15).

The disk herniation in the cat presented herein could have resulted from abnormal intervertebral stresses due to the block vertebrae. A pre-existing malformation of the intervertebral disk space cannot, however, be ruled out. Indeed, degenerative changes in the intervertebral space are observed in 100% of humans affected by congenital fusion of the cervical vertebrae (Klippel-Feil syndrome), leading to disk protrusion and neurological deficits in some patients. In these cases, clinical problems often develop in adult life although the fused vertebrae are present at birth (18). In addition, degenerative age-related changes in the intervertebral disk may have predisposed this cat to disk protrusion at the age of 10 (5, 19).

There are few reports of surgical decompression in cats with thoracolumbar disk ex-
Trusion (6–13). In these cases, decompression was achieved either by laminectomy (6, 7) or standard hemilaminectomy with or without durotomy (8–12). Both techniques were associated with a good clinical outcome. However, the onset of clinical signs in most of these reports was acute. In chronic disk disease, removal can be technically demanding due to encapsulation of the disk and adhesions to the dura mater or venous sinuses. The incomplete removal of extruded or protruded disk material or iatrogenic spinal cord trauma during the attempt to remove the disk can adversely affect surgical outcome. In 2004, thoracolumbar corpectomy was first described in dogs for the treatment of chronic disk herniation (1, 20) as an alternative to hemilaminectomy, and was reported to be associated with very few complications (13). The major advantage of corpectomy over hemilaminectomy is the lack of spinal cord manipulation and associated iatrogenic spinal cord trauma, although no biomechanical studies have been performed comparing corpectomy to hemilaminectomy or laminectomy. A possible disadvantage of this procedure is increased surgical difficulty due to the small size of feline vertebrae.

References

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Lateral corpectomy in a cat

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