Three Consecutive Ventral Slots for the Treatment of Cervical Intervertebral Disk Disease in a Dog

Merbl, Y.,* Shamir, M.H., Chamisha, Y., Peeri, D., Benzioni, H. and Chai, O.

Koret School of Veterinary Medicine, The Hebrew University of Jerusalem, Rehovot, Israel.

* **Correspondence:** Dr. Orit Chai, DVM, Diplomate ECVN, Department of Neurology and neurosurgery, Koret School of Veterinary Medicine, The Hebrew University of Jerusalem, Rehovot 76100, Israel. Email: orit18m@gmail.com

ABSTRACT

An 8.5 year-old neutered Pomeranian female dog presented with non-ambulatory tetraparesis underwent computed tomography that revealed calcified disk extrusions at C3-C4, C4-C5 and C5-C6 intervertebral spaces, causing severe extradural compressions. A triple ventral slot decompression surgery was performed. The dog regained ambulation after surgery with only mild deficits remaining.

Keywords: Canine; tetraparesis; Cervical intervertebral disk disease; Surgery.

INTRODUCTION

Cervical intervertebral disk disease (IVDD) causing compression of the spinal cord or nerve roots is a common and well-documented condition in veterinary medicine, accounting for 16%-25% of all IVDD cases in dogs (1, 2, 3). IVDD can be treated either conservatively or surgically. Most dogs will benefit from surgical decompression, particularly if cervical pain is accompanied by gait impairment (4).

Numerous techniques for cervical spine decompression in dogs exist, including disk fenestration, ventral slot decompression (VSD), dorsal laminectomy, hemilaminectomy (5) and slanted slot (6). Because the disk frequently herniates dorso-medially, VSD is the most common surgical procedure (3). The limitations of this approach include impaired visualization of the spinal cord and limited access to lateral disk extrusions (3), both due to the need to preserve vertebral stability.

Diagnosis of multiple cervical disk herniations is not uncommon. Indeed, previous studies reported an average of 1.4-1.5 disk herniations per affected disk space (7, 8). However, limited data exists regarding the application of consecutive ventral slots in cervical disk disease (3, 9) and the exact surgical technique by which the ventral slots were performed in these cases to maintain spinal stabilization was not detailed. Here, we report a successful triple ventral slot decompression surgery performed in successive cervical intervertebral disks of a small toy dog.

MATERIALS AND METHODS

Case report

An 8.5-year-old neutered Pomeranian female dog weighing 3.5 kg was referred to the Koret Veterinary Teaching Hospital with a chief complaint of gait abnormality and reluctance to move, which had deteriorated during the previous 10 days to a non-ambulatory state. Medical history included left systolic heart murmur that was treated regularly with furosemide (1mg/kg PO, SID) and enalapril maleate (0.5 mg/kg PO SID). Physical examination on admission revealed an alert and responsive dog with normal vital signs and a heart murmur as described.

Neurological abnormalities included asymmetrical, non-ambulatory tetra-paresis, which affected the right side more severely. Segmental spinal reflexes were intact in all 4 limbs; hence, the lesion was localized to spinal cord segments C1-C5.

Complete blood count (Blood count analyzer, Abacus, Diatron, Wien, Austria) results were normal. Electrolyte disturbances (sodium, 134 mmol/L; reference range, 145-154 mmol/L and chloride, 94.7 mmol/L; 108-118 mmol/L) were detected on biochemistry analysis (Roche Hitachi 917 Chemistry Analyzer, Hitachi, Tokyo, Japan) and were attributed to the treatment with diuretics. High blood glucose level of 131 mg/dL (reference range, 64-123 mg/dL) was attributed to stress.

The anesthetic protocol that was used for both diagnosis and surgery was as follows: pre-medication with acepromazine maleate (0.01 mg/kg subcutaneously) and morphine hydrochloride (Teva medical Ltd., Ashdod, Israel, 0.5 mg/kg subcutaneously); induction with propofol (1 mg/kg IV, Taro pharmaceutical, Yakum, Israel) and assival (0.5 mg/kg IV, Teva Industries, Petach-Tikva, Israel) and maintenance of anesthesia with isoflurane in 100% oxygen, delivered through a standard non-rebreathing circuit attached to an anesthesia machine.

Preoperative Care

Cervical radiographs were performed under general anesthesia, and revealed narrowed intervertebral disk spaces at C2-C6. Cerebrospinal fluid (CSF) analysis showed normal cell count (2 cells/μL) and cytology. Computed tomography (CT) demonstrated calcified disk herniations at intervertebral disk spaces C3-C4, C4-C5 and C5-C6 (Fig 1A). Disc material occupied about 75% of the spinal canal height at the C3-C4 level, 50% at C4-C5 and approximately 30% at C5-C6. Spinal cord compression was more prominent on the right (Fig 1B), ventrally and extending slightly to the left above each of the herniated disc spaces (Fig 1, C-D), respectively. Although the disk extrusion at C3-C4 correlated best with the clinical signs, all 3 extrusions caused substantial

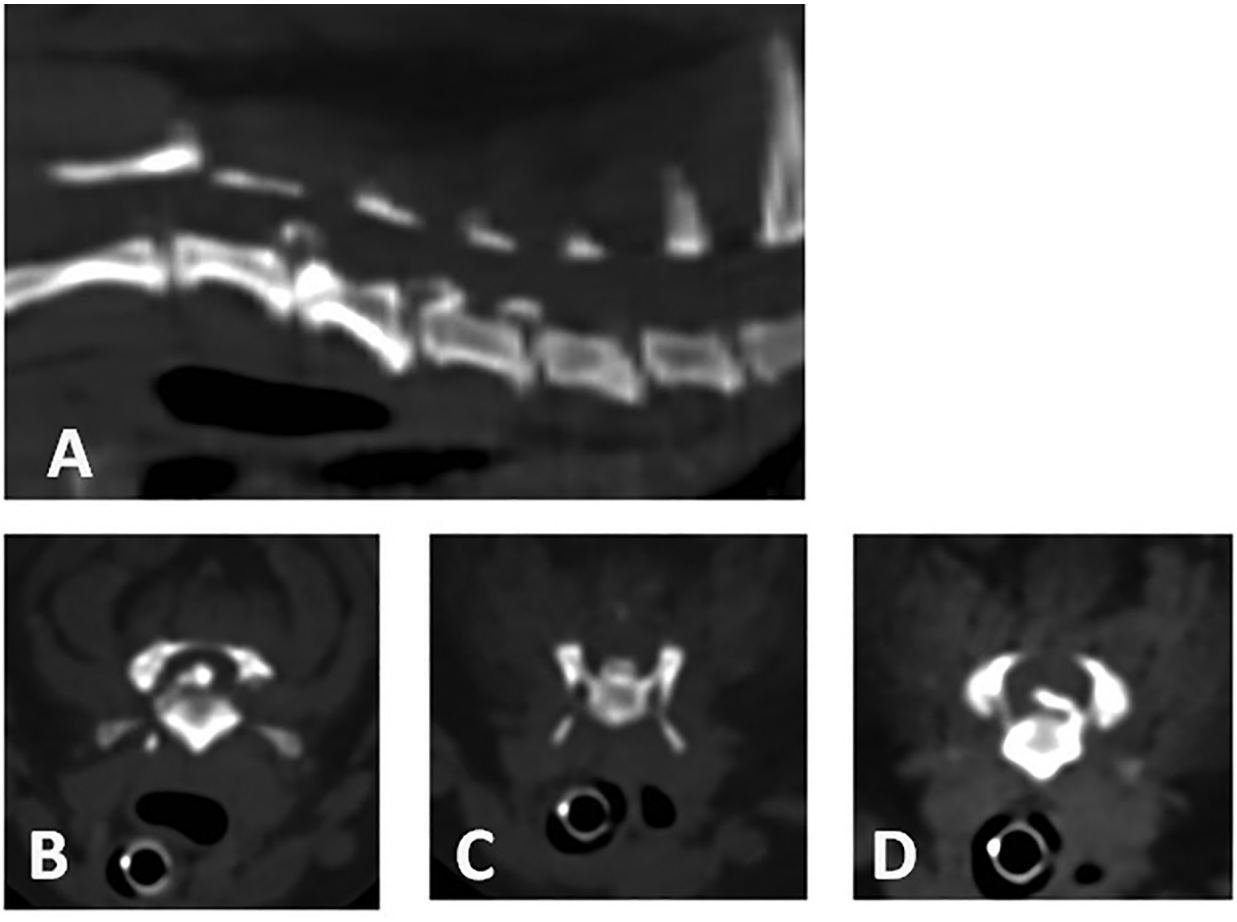

Figure 1: CT images of the affected spinal region. (A) Reconstructed sagittal view of the neck showing mineralized disc material in the vertebral canal at intervertebral spaces C3-C4, C4-C5 and C5-C6. (B-D) Transverse slices show mineralized disc in the spinal canal at intervertebral disk spaces C3-C4, C4-C5 and C5-C6, respectively, causing spinal cord compression.

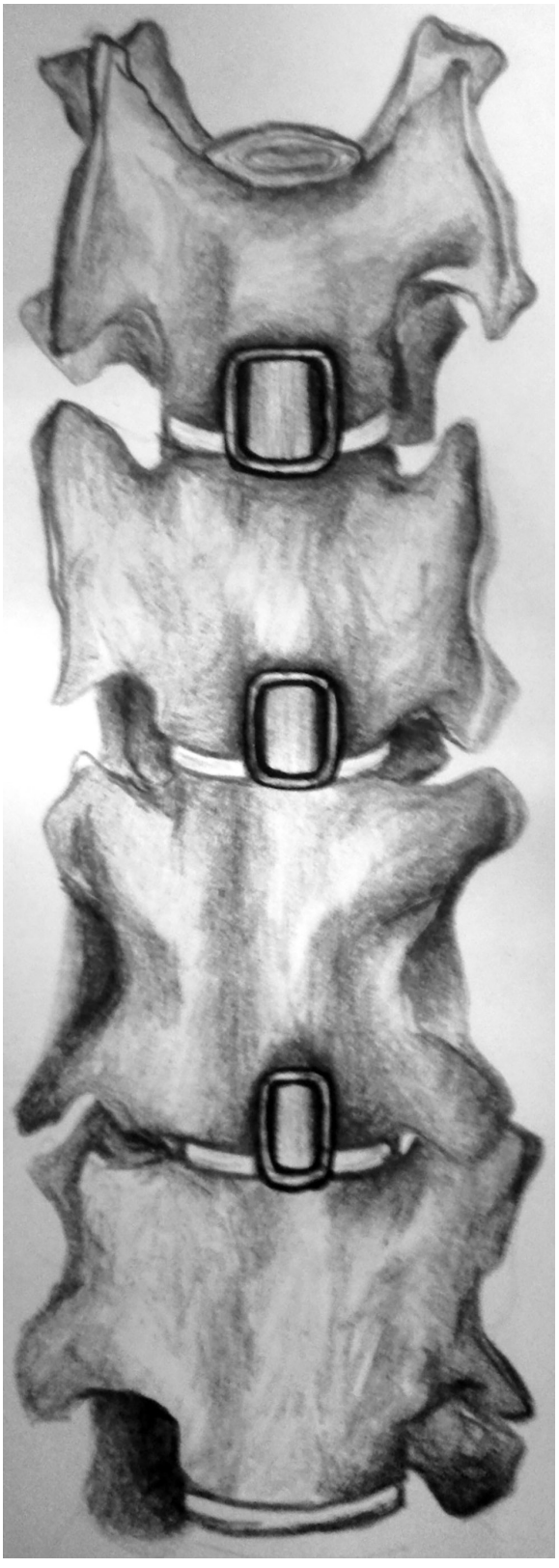

Figure 2: Illustration of the consecutive ventral slot procedure that was performed across C3-C6, showing the decreased width of the second and third slots.

spinal cord compression, and were considered to contribute to the severe clinical signs. Therefore, to improve the surgical outcome, multiple ventral slots were considered necessary.

Surgical technique

Three consecutive ventral slots were performed over the C3-C6 vertebrae. A routine approach (5) to the ventral aspect of the involved vertebrae was taken. Slot sizes and shapes were modified to prevent destabilization of the cervical spine. Slots borders were positioned to include the ventral process of the cranial vertebra, while the cranial border and the end of the annulus fibrosus of the adjacent disk were the most caudal boundary. The cranial aspect of each caudal vertebra was spared (Fig 1& 2). Slot size did not exceed one third of the vertebral body width and one third of its length. Herniated disk material was removed from each slot until the spinal cord was visualized. The herniated disk material that was removed from C3-C4 was softer and less fibrotic than the material that extruded from C4-C6. The surgical site was closed routinely and the dog's neck was stabilized using a cervical splint to minimize movement.

Postoperative Care

Included administration of cefazolin (25 mg/kg, IV, twice daily for 5 days) and morphine (0.5 mg/kg subcutaneously every 6 h for 1 day). The dog's neurological status improved over the first 48 hours following surgery, showing stronger voluntary movements in all limbs. The owners were instructed to keep the dog in a cage for additional 10 days, with the exception of 3 short daily walks.

Follow-up examination 11 days after surgery revealed an ambulatory tetraparetic dog with no evidence of neck pain. Conscious proprioception (CP) deficits were noted in all 4 limbs. One-month follow-up revealed an active, pain-free dog with mild CP deficit in both hind limbs only. Long-term follow-up through telephone communication with the owners indicated a stable neurologic status for 2.8 years. Recently exercise intolerance was reported, which is presumed to be related to the dog's cardiac disease.

DISCUSSION

Several studies were conducted to assess optimal slot dimensions in order prevent postoperative vertebral instability. Recommendations regarding length and width of the slots

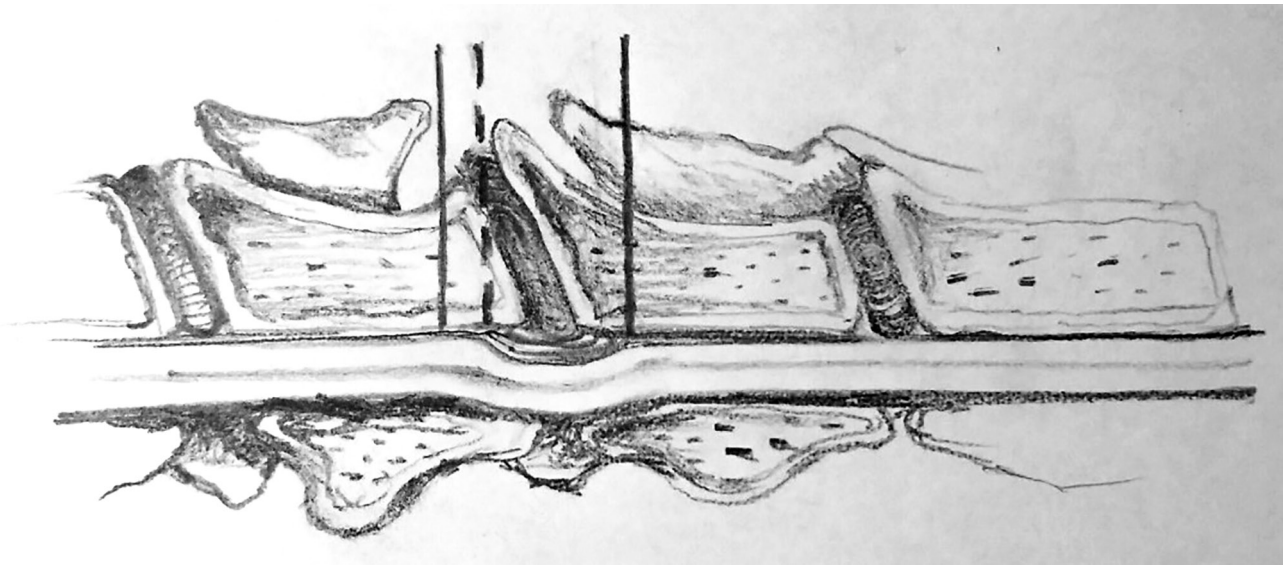

Figure 3: Midsagittal illustration of the cervical vertebrae, the spinal cord and the herniated disk. The continuous lines indicate the cranial and caudal borders of standard ventral slot. The dashed line marks the caudal border of the slot in our case, which preserves the craniodorsal aspect of the caudal vertebra.

vary considerably, ranging from 25% to 33% of the width of the vertebral bodies involved and from 33% to 75% of their length (3). A study in canine cadavers that examined the effect of the width of disk fenestration and ventral slots on the biomechanics of the C5-C6 vertebral motion unit concluded that in both procedures, up to 50% of the mean width of the vertebral bodies may be clinically acceptable (10). Another retrospective clinical study found that 7 of 8 dogs that underwent VSD surgery with a slot width of at least half of the vertebral body suffered from vertebral subluxation (11). These findings imply that a wide ventral slot may contribute to post-operative instability of the vertebrae.

During the surgical procedure described here, conservative ventral slots were performed in order to maintain stability as much as possible. To this end, the width and length of the slot was less than one third of the cranial vertebral body, and the ventral aspect of the caudal vertebra at each intervertebral joint was spared. Because the drilling through the vertebral bodies was perpendicular to the spinal canal and the disc space was diagonal, the cranio-dorsal aspect of the vertebral body caudal to the herniated disc was included in the slot (Fig 3). All slot widths and lengths were therefore within the proportions suggested in the literature.

To date, there is limited data in the literature regarding multiple cervical disk extrusions. The diagnosis of cervical spinal cord compression due to multiple site disk disease is not infrequent (3, 7, 8, 9), and it is assumed that the extrusions in these cases do not occur simultaneously. When such presentations occur, the disk that correlates with the most acute clinical signs is treated, while the others are usually ignored. This decision can be supported by myelography or Magnetic Resonance Imaging (MRI) results, which provide information regarding the presence of spinal cord edema or inflammation above the most current and acute disk extrusion. In the case presented here, the disk extrusion in C3-C4 was suspected to contribute most to the clinical signs. However, the degree of spinal cord compression at the levels of C4-C5 and C5-C6 was too high to be ignored and, thus, these herniations were treated concurrently. During surgery, it was apparent that the extruded disk material at the level of C3-C4 was more recently herniated as compared to the more firm, fibrotic disk texture at C4-C5 and C5-C6.

Stabilization with or without distraction may be indicated in large dogs following a vertebral slot procedure for caudal cervical IVDD (12). In our case, three consecutive intervertebral spaces of the mid-cervical area were involved in a toy breed dog. Internal stabilization was avoided due the small size of the vertebrae and because in such a small dog the mechanical loads applied to these intervertebral joints are minimal.

The treated dog improved significantly post-surgery, although residual hind limb ataxia and CP deficit remained.

To the best of our knowledge, this is the first report of a modified ventral slot technique that can be applied in small-breed dogs with multiple disk herniations. Further studies are needed to better evaluate the biomechanical characteristics of this technique. Nevertheless, when surgical decompression is indicated in more than one cervical disk space, the described approach of conservative and consecutive ventral slots should be considered.

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