Article published online: 2022-10-26

Double Adjacent Ventral Slots in Cervical Disc Extrusion with Epidural Haemorrhage in Four French Bulldogs

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VCOT Open 2022;5:e106–e110.

Abstract

Four French bulldogs were presented with a history of cervical pain and/or signs of myelopathy and were diagnosed with an acute cervical intervertebral disc extrusion (IVDE), associated with epidural haemorrhage (EH). The lesion was classified as IVDE with EH by a board-certified radiologist based on contrast-enhanced computed tomography images. All dogs were treated with two adjacent ventral slots that confirmed diagnosis. The decompression was assessed by measurement of the amount of residual material on computed tomography studies, and the outcome was evaluated by clinical recheck. All dogs recovered uneventfully after the surgery. This case series describes the first detailed report of extensive cervical IVDE with EH where double adjacent ventral slots was used in a treatment of such lesion.

Keywords
- neurosurgery
- canine
- ventral slot
- epidural haemorrhage
- disc extrusion

Introduction

Hansen type I or acute intervertebral disc extrusion (IVDE) refers to extrusion of degenerated nuclear material into the spinal canal and typically affects chondrodystrophic dogs with an acute onset. Acute IVDE may cause ventral, ventrolateral or circumferential compression of the spinal cord. Acute cervical IVDEs are estimated to represent between 14 and 25% of all intervertebral disc disease in dogs.[1] In order to treat cervical IVDE, different surgical techniques have been described, including disc fenestration,[1,2] ventral slot (VS),[3] slanted slot,[4] dorsal laminectomy and hemilaminectomy.[5] The choice of the technique depends mostly of the localization and extension of the lesion and of the surgeon's preference and experience. Ventral slot is the most commonly used technique for ventral or ventrolateral lesions.[3,4,6] The most serious complications of VS include aspiration pneumonia, haemorrhage from internal venous sinuses needing transfusion and vertebral instability.[7] The latter may be reduced by respecting the maximal width and length of VS (ideally 30% of the vertebral width and length and certainly not exceeding 50% of the width).[8,9] For dorsal or lateral lesions, the most commonly described techniques are dorsal laminectomy and hemilaminectomy.[1,5,10,11]

Acute IVDE can lead to epidural haemorrhage (EH) by disruption of one of the vertebral sinuses[1,12] and has been referred to as acute IVDE (Hansen Type I) with extensive EH.[13] Epidural haemorrhage is most commonly encountered with thoracolumbar disc extrusions[12,14–16] and may lead to severe spinal cord compression over more than one intervertebral space. The extravasation of blood may increase the

received
October 15, 2021
accepted after revision
July 1, 2022

DOI https://doi.org/10.1055/s-0042-1757348.
ISSN 2625-2325.

Georg Thieme Verlag KG, Rüdigerstraße 14, 70469 Stuttgart, Germany

inflammatory response at the site of the lesion and exacerbate spinal pain.[12] The presence of an EH may also be correlated with progression of spinal cord damage.[17] Extensive EH has been previously described in the thoracolumbar region. In that study, the surgical technique used was extensive hemilaminectomy.[12] In previous reports, EH within the cervical vertebral canal was mainly associated with surgical complications, suspected vascular abnormalities, neoplasia or a coagulopathy,[7,18] but reports describing acute cervical IVDE with extensive EH are currently lacking.

In this case series, we describe four cases of acute cervical IVDE with EH successfully treated with double adjacent VSs.

Case Histories

Four middle-aged (3–7 years old) male (three entire, one neutered) French bulldogs were presented with acute onset of neurological signs compatible with cervical myelopathy. Medical treatment prior to referral consisted of nonsteroidal anti-inflammatory drugs and tramadol in cases 1 and 3. Case 1 was presented with nonambulatory tetraparesis with absent postural reactions. Cases 2 and 3 exhibited asymmetrical ambulatory tetraparesis with decreased postural reactions (left- and right-sided, respectively). Case 4 was nonambulatory, showing had hindlimbs paraparesis with forelimbs paraplegia with absent postural reactions in all limbs. The hindlimbs spinal reflexes (withdrawal and patellar) were normal in all cases. The forelimbs withdrawal reflex was decreased in the left forelimb in case 4, it was normal in cases 1, 2, 3 and in the right forelimb in case 4. Cranial nerves examination showed no abnormality. The neurolocalization was C1 to C5 in cases 1, 2, 3 and C6 to T2 in case 4. Physical examination was unremarkable in all dogs.

All the computed tomographic (CT) studies were performed using a 64-slice CT scanner (Toshiba Aquilion 64; American Medical System, Tustin, California, United States). Dogs were put under general anaesthesia and placed in dorsal recumbency. For contrast-enhanced studies, intravenous iodine contrast agent was injected (iopamidol 300 mg/mL) intravenously. Pre- and postcontrast images were always available for review. Results are summarized in ►**Table 1**. A large amount of mixed strongly (mineralized) to slightly hyperattenuating material compressing the spinal cord was identified within the vertebral canal in all cases (►**Fig. 1**). The density of the lesions varied between 35 and 232 Hounsfield unit. The extruded material extended over more than one intervertebral space in all cases. The primary site of extrusion was suspected based on the observation of a collapsed intervertebral space. The extent of the lesion varied from 1.3 to 2.8 times the length of the C5 vertebral body (►**Fig. 1**). The extruded material extended caudally in cases 1, 2, and 4, and both cranially and caudally in case 3. The maximal compression ratio (area of the compressive material divided by area of vertebral canal on transverse sections multiplied by 100) was calculated at worst compressive site on postcontrast soft-tissue window and reached 36 to 58%. The compressive material was located ventrolateral to the spinal cord in all cases, left-sided in cases 1, 2, and 4, right-sided in case 3. Small amounts of hyperattenuating material were also visible dorsal to the spinal cord in 3 cases (cases 1, 2, and 4) (►**Fig. 1**).

Based on CT images, a presumptive diagnosis of acute IVDE with EH was made. Surgical treatment by double adjacent VSs was chosen in all four cases and was performed the same day. A standard approach to the ventral aspect of the cervical spine was performed. A first VS was performed at the site of extrusion, using an electric drill with a 3 mm burr

Table 1 Preoperative and postoperative computed tomographic (CT) findings

Case	1	2	3	4
Extrusion site/second site operated	C5–C6/C6–C7	C4–C5/C3–C4	C5–C6/C6–C7	C4–C5/C5–C6
Extension of the compression from cranial to caudal, compared to the length of C5 vertebral body (rostro caudal extension of the lesion [cm]/ length of C5 vertebral body [cm])	2 vertebral bodies	2.8 vertebral bodies	1.3 vertebral bodies	2.2 vertebral bodies
Lateralization of the material on CT	Ventrolateral (left-sided)	Ventrolateral (left-sided)	Ventrolateral (right-sided)	Ventrolateral (left-sided)
Dorsal extension of compressive material	Yes, mild	Yes, minimal	No	Yes, minimal
Maximal compression ratio and localization of extruded material (on transverse section)	50%, middle of C6, left sided	51%, caudal part of C4, left sided	36%, middle C6, right sided	58%, middle C5, left sided
Maximal residual compression ratio and localization of residual material (on transverse section)	20%, left sided, lateral (rostral part of C6) and foraminal (C6–C7)	14%, left sided, caudal part of C4 and rostral part of C5 vertebral body, foraminal (C4–C5)	15%, right sided, rostral part of C6, foraminal C5–C6	0% within the vertebral canal, left sided foraminal (C4–C5)

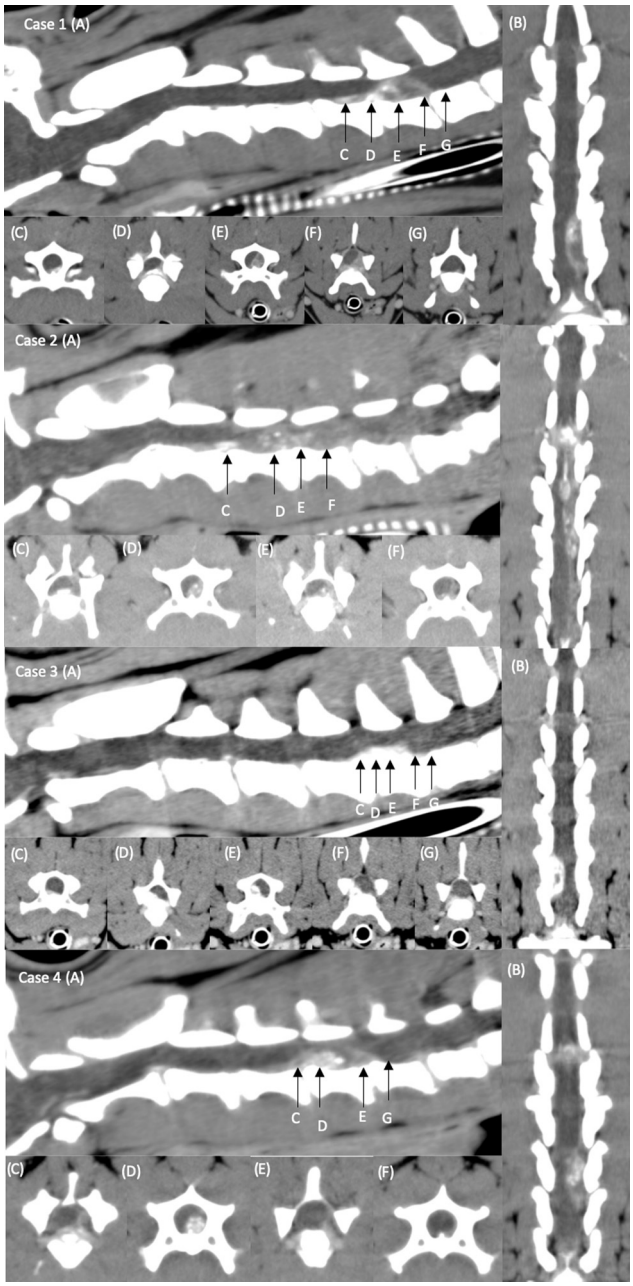

Fig. 1 Post-contrast (soft tissue window) computed tomography images of cases 1 to 4. In soft tissue window, before surgery: (**A**) Sagittal view (cranial to the left, dorsal on top of the image), (**B**) dorsal view (cranial on the top of the image, the left is on the right side of the image), (**C–F**) Transverse images (the left is on the right side of the image). An extensive heterogeneously hyperattenuating material (compared to the spinal cord) suggestive of extruded degenerated disc mixed with epidural haemorrhage is observed in the four cases, compressing the spinal cord. The black arrows on the sagittal images correspond to the area of the sections of transverse images.

(Air Pen Drive; Synthes, Wrington, United Kingdom). The compressive material was removed using small curettes and Kerrison forceps, revealing a mixture of typical degenerated mineralized disc material mixed with EH. Vertebral sinus bleeding was controlled with temporary application of oxidized regenerated cellulose haemostat (Surgicell; Ethicon, Inc, Johnson & Johnson, Edinburgh, Scotland) in all cases. Based on CT images of the extension of extruded material, a second VS was performed at the adjacent disc site, caudal to the extrusion in three cases (cases 1, 3, and 4) and cranial to it in one case (case 2) to retrieve the remaining compressive material that could not be retrieved through with the first VS. The procedure was identical to first VS. The material retrieved was also mineralized disc with EH. Immediate postoperative CT examination was done in all cases and showed a satisfying decompression of the spinal cord in all cases (►**Fig. 2**). However, a slight amount of extradural material persisted within the intervertebral foramen at extrusion site in all dogs and at second operated site in two dogs and laterally to the spinal cord within the vertebral body in three dogs. The amount of residual maximal compression ratio varied between 0 and 20% (►**Table 1**). The width of all the slots did not exceed 50% of the width of the corresponding vertebra, but it exceeded 30% in cases 2 and 4. The length of the VSs did not exceed 30% of the length of the vertebral bodies cranial and caudal to them. In the middle vertebra, the combined length of the cranial and caudal slots involved 46 to 56% of the total vertebral length.

Postoperative treatment included opioids and nonsteroidal anti-inflammatory drug. All dogs were ambulatory at the time of discharge, 24 to 48 hours after the surgery. The owners were advised to enforce strict rest in a cage or confined space to their dogs for 3 weeks. Only short walks outside on a leash and harness to urinate and defecate were permitted. This was followed by another 3 weeks period with gradual increase in controlled exercise. Follow-up examination 2 weeks after surgery showed a complete resolution of neurological signs in three dogs (cases 1, 2, and 4) and a mild residual right forelimb paresis in case 3. There was no cervical pain in any of the dogs. All four dogs were considered normal by their owner on a telephone follow-up, 3 to 5 years after the surgery and none of them had showed any sign of relapse during this period.

Discussion

Multiple VSs have already been reported as a treatment for multiple adjacent or nonadjacent cervical disc extrusions,[3,6,7] but there has been no report describing two adjacent VSs in the treatment of solitary acute IVDE with EH or in the treatment of lesions localized laterally or dorsally. Ventral slot provides a good access to the floor of the vertebral canal.[1,3,4,6] It carries a risk of complications and disadvantages such as haemorrhage from venous sinus laceration, lack of adequate exposure to lateralized lesions, incomplete spinal cord decompression or vertebral subluxation.[18,19] No such complications were observed in the four cases presented. The risk of subluxation can be reduced by respecting the recommendations regarding the maximal width and length of the slot.[8,9] Performing two contiguous VSs limits the restrictions regarding the length of the VS. In our cases, only the recommendation not to exceed 50% of the vertebral width was respected. The recommendation that the slot length should be less than 30% of the vertebral body length was respected in the most cranial and in the most caudal of the 3 vertebrae involved, but this rule could not be

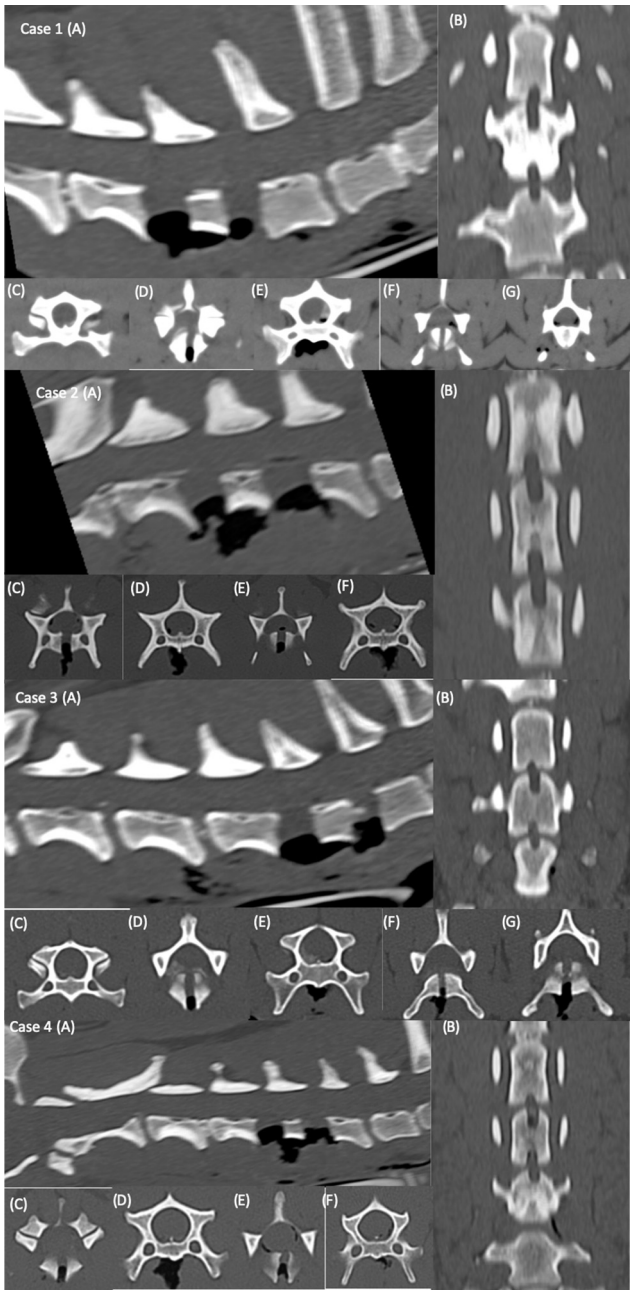

Fig. 2 Post-surgical computed tomography images of cases 1 to 4, in bone window, after double ventral slots: (**A**) Sagittal view (cranial to the left, dorsal on top of the image), (**B**) dorsal view (cranial on the top of the image, the left is on the right side of the image), (**C–F**) transverse images (the left is on the right side of the image). The cranial to caudal extension of the double ventral slot is better appreciated on the sagittal (**A**) and dorsal (**B**) reconstructions. The transverse images show the efficient decompression of the spinal cord with minimal residual hyperattenuating material in cases 1 and 3.

applied to the middle vertebra (located between the two VS). The combined length of the two slots corresponded to 46 to 56% of the total length of the middle vertebra.

In our cases, the extruded material was mostly located ventrolaterally, although some material extended to the dorsal aspect of the vertebral canal in cases 1, 2, and 4. Hemilaminectomy and dorsal laminectomy tend to be more adequate for the treatment of lesions localized respectively laterally and dorsally within the vertebral canal[1,5,10,11] and may have been an alternative in our cases. However, these procedures have been associated with some disadvantages compared to VSs. Muscle dissection for dorsal or lateral approaches is more traumatic and risks of nerve root damage and/or haemorrhage from the internal vertebral artery are greater.[5,10,11] Early postoperative worsening has been reported in dogs treated for acute IVDE by dorsal laminectomy or hemilaminectomy,[11] whereas this was not observed in our cases treated by double VSs. Extensive cervical hemilaminectomy over more than one intervertebral space has not been described yet and may significantly increase the risk of subluxation. This risk may also exist in double VSs but was not encountered in our cases. No complication was observed in our cases at the short-term and at 3 to 5 years long-term follow-up. This follow-up period is longer than those described in other studies describing VS complications.[2,4,7,19] Nevertheless, clinical assessment was only performed at a 2-week follow-up examination. Long-term assessment was performed only through a telephone conversation with the owner. Minor deterioration or potential instability may indeed have occurred shortly after the surgery and cannot be excluded, as it might have been missed or forgotten by the owners. Experimental cadaveric studies and larger number of cases are necessary to compare this risk with other techniques.

Despite the ventrolateral localization of the compression in our cases, the VSs were sufficient to remove a large amount of extruded material, as assessed on postoperative CT. We hypothesize that the removal of extruded material, including material located lateral and dorsal to the spinal cord, was facilitated by short delay between the beginning of the signs and the surgery. There was no evidence of adhesions between the material retrieved and the dura mater or the periosteum of the vertebral canal at surgery.

Another question is whether a double VS was necessary, considering the fact that haemorrhagic component of lesion may resolve spontaneously over time. It is unfortunately impossible to evaluate this hypothesis retrospectively, as we do not have a control group of dogs with the same type of lesion to compare with. The decision to perform double VSs was made based on the extent of the lesion and the fact that the CT density of the extruded material was compatible with a mixture of haemorrhage and degenerated disc (Hounsfield unit: 35–232). Furthermore, in three cases, the compression was maximal at the middle point of vertebral body, and we expected that it would not be possible to remove all the compressive material through a single VS.

A discrepancy was noticed between neuroanatomic localization (C6–T2 myelopathy) and imaging findings in case 4 (extrusion site at C4–C5). However, EH extended caudally in this case, causing severe compression of the cervical intumescence. Furthermore, it has been reported that the withdrawal reflex is not precise for predicting cervical myelopathy localization.[9] Another possible explanation is variations in spinal roots contributing to the formation of brachial plexus. It has been showed that the C5 segment being involved in approximatively 21% of the dogs.[20]

All of the dogs included in our series were French bulldogs. The small number of cases does not allow us to determine if there is a breed predisposition for EH in the cervical region. French bulldogs are overrepresented in our hospital for cervical and thoracolumbar IVDE. Nevertheless, a recent study found a predisposition for thoracolumbar EH in this breed.[16]

Magnetic resonance imaging was not available on-site at the time the animals were presented. Intramedullary lesions may have been underestimated using CT.[21] However, CT is a good imaging diagnostic modality in chondrodystrophic dogs with suspected disc extrusion.[22] In these breeds, the degenerated disc material is frequently partially mineralized and therefore easily detectable on CT.[22] If the concomitant haemorrhage is present, it will appear slightly hyperattenuating to the spinal cord.[15]

This retrospective case series describes the first detailed report of extensive cervical IVDE with EH and treated by double VS. Further prospective, controlled studies based on a larger number of cases would be required to confirm that double VS at adjacent intervertebral spaces provides a clear advantage, but this case series suggests it may provide a safe approach in such cases.

Conflict of Interest

No conflict of interest to declare.

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