Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Functional spinal cord decompression through modified ventral slot technique in a dog with persistent residual mineralized cervical disc material: a case report

Vitoria Chesini Malvessi
Universidade Federal de Santa Maria
Julia da Silva Rauber
Universidade Federal de Santa Maria
João Felipe da Silva Mielke
Universidade Federal de Santa Maria
Julya Nathalya Felix Chaves
Universidade Federal de Santa Maria
Amanda Miwa Takamori Sekita
Universidade Federal de Santa Maria
Luiza Tonietto Mangini
Universidade Federal de Santa Maria
Pollyana Freisleben
Universidade Federal de Santa Maria
Diego Vilibaldo Beckmann
Universidade Federal de Santa Maria
Alexandre Mazzanti
alexandre.mazzanti@ufsm.br
Universidade Federal de Santa Maria

Case Report

Keywords: ventral slot, spinal cord compression, calcified disc extrusion, dura mater adhesion, dog

Posted Date: June 11th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9727539/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background: Severely mineralized cervical intervertebral disc extrusion may represent a substantial surgical challenge in dogs, particularly when the extruded material is firmly adherent to the dura mater. In these cases, aggressive surgical manipulation and complete removal of the extradural material may increase the risk of iatrogenic spinal cord injury. However, limited information is available regarding long-term clinical outcomes when complete anatomical removal of mineralized disc material is not feasible.

Case presentation: A 6-year-old mixed-breed female dog was presented with chronic cervical pain and ambulatory tetraparesis. Computed tomography revealed a hyperattenuating extradural lesion between C2 and C3 occupying approximately 55% of the vertebral canal and causing marked spinal cord compression. Conservative treatment was initially attempted but failed to control clinical signs. Surgical decompression through a ventral slot approach was subsequently performed. Intraoperatively, the extradural material exhibited severe mineralization, osseous-like consistency, and marked adhesion to the dura mater, preventing safe complete removal. Due to the high risk of iatrogenic spinal cord injury, a modified ventral slot technique with lateral enlargement of the osseous window was performed to achieve functional spinal cord decompression without aggressive manipulation of the residual material. Marked neurological improvement was observed in the immediate postoperative period, followed by sustained clinical recovery. Computed tomography performed 20 months after surgery demonstrated persistence of residual mineralized extradural material within the vertebral canal; however, the dog remained neurologically normal and free of medication.

Conclusion: This report demonstrates that favorable long-term clinical outcomes may be achieved in dogs with severely mineralized cervical disc extrusion through functional spinal cord decompression, even when complete anatomical removal of the extradural material is not feasible. Avoidance of aggressive manipulation of mineralized material adherent to the dura mater may reduce the risk of iatrogenic injury while still allowing substantial neurological recovery.

Background

Intervertebral disc degeneration (IVDD) may result in protrusion or extrusion of disc material into the vertebral canal, leading to spinal cord compression and neurological deficits of varying severity (1). Extruded disc material may become mineralized, acquiring a rigid and firm consistency, or remain non-calcified, presenting a softer texture that is generally easier to remove surgically (5). Most intervertebral disc calcifications occur in the thoracolumbar region, accounting for approximately 71% of reported cases (6, 10, 11); however, cervical spinal segments may also be affected (2, 5).

The surgical management of cervical disc extrusions and protrusions is particularly challenging because of the anatomical complexity of the region and the proximity of critical neurovascular and respiratory structures (4). In these cases, ventral slot decompression is considered the standard surgical technique for spinal cord decompression (3). However, compared with surgical approaches used in the thoracolumbar spine, cervical procedures are associated with a higher risk of intraoperative and

postoperative complications (4). Reported complications include hypotension, hypoventilation, hemorrhage of the vertebral venous plexus, injury to the recurrent laryngeal nerve and esophagus, as well as incomplete spinal cord decompression (4, 8, 12).

Despite the clinical relevance of mineralized disc extrusions, there is limited information in the veterinary literature regarding the necessity and implications of complete surgical removal of mineralized disc material, particularly in the cervical spine. In some cases, the rigid consistency of the material and its adhesion to the dura mater may hinder safe removal, increasing the risk of iatrogenic spinal cord injury during surgical manipulation. Furthermore, extraction of this material may require the use of more aggressive surgical instruments, further increasing the risk of neural injury. A case of extrusion of a calcified cervicothoracic disc was described in which complete removal of the material was not possible due to the high risk of spinal cord injury. However, the patient underwent euthanasia, which prevented the evaluation of the long-term clinical outcome (6).

The veterinary literature still provides limited data regarding the long-term clinical outcome of dogs undergoing cervical spinal cord decompression in the presence of severely mineralized disc material that cannot be completely removed. To the authors' knowledge, long-term follow-up of a dog with persistent residual cervical mineralized disc material adherent to the dura mater after modified ventral slot decompression has not been previously described.

Therefore, the present report describes a case of cervical spinal cord compression caused by calcified disc extrusion treated using a modified ventral slot technique without complete removal of the residual mineralized material adherent to the dura mater, resulting in sustained neurological improvement and long-term clinical stability.

Case Presentation

Clinical Features

A 6-year-old intact mixed-breed female dog weighing 17.6 kg was presented to the Veterinary Neurology and Neurosurgery Service of the Veterinary Teaching Hospital at the Federal University of Santa Maria. The clinical history revealed acute onset cervical pain associated with reluctance to climb stairs and jump, with persistent clinical signs for approximately six months.

Physical examination revealed firm, erythematous, dry, and crusted skin lesions distributed mainly over the ventral abdomen and right pelvic limb. Vital parameters, including heart rate, respiratory rate, rectal temperature, capillary refill time, mucous membrane color, femoral pulse quality, and hydration status, were within normal limits.

Neurological examination demonstrated kyphotic posture, cervical muscle rigidity, reduced cervical range of motion, and short-strided gait associated with mild ambulatory tetraparesis, more pronounced in the thoracic limbs. Postural reactions and spinal reflexes were normal in all limbs. Palpation of the

cervical epaxial musculature elicited marked pain. The dog had been receiving oral prednisolone (1 mg/kg twice daily) since the onset of clinical signs.

Imaging and laboratory findings

Computed tomography (CT) of the cervical spine (C1–C5) revealed hyperattenuating extradural material located between C2 and C3, consistent with mineralized intervertebral disc extrusion, occupying approximately 55% of the vertebral canal and causing marked spinal cord compression (Fig. 1). Complete blood count and serum biochemistry were also performed. Biochemical abnormalities included increased alanine aminotransferase (ALT) and alkaline phosphatase (ALP) activities, measuring 402 U/L and 2098 U/L, respectively.

Considering the dermatological lesions, laboratory abnormalities, and serum electrolyte findings, including ionized calcium concentration of 1.14 mmol/L (reference interval: 1.3–1.5 mmol/L), abdominal ultrasonography, skin biopsy, and histopathological examination were performed, resulting in a diagnosis of iatrogenic hyperadrenocorticism associated with calcinosis cutis. Due to these concurrent conditions, conservative management of the cervical spinal cord compression and gradual corticosteroid withdrawal were initially elected. Conservative treatment consisted of strict cage rest for 30 days, pregabalin (4 mg/kg orally twice daily for 30 days), dipyrone (25 mg/kg orally three times daily for 5 days), and tramadol hydrochloride (4 mg/kg orally three times daily for 5 days). Additionally, three intravenous administrations of ketamine (0.8 mg/kg) combined with lidocaine (2 mg/kg) were performed every 72 hours as part of the analgesic protocol.

After 15 days of conservative treatment, persistent cervical hyperesthesia prompted surgical intervention through a ventral slot approach.

Surgical procedure and post-operative care

During surgery, initial attempts to remove the extradural disc material using delicate surgical instruments were unsuccessful because of the severe mineralization and osseous-like consistency of the material. Additional attempts using cutting instruments, including a dental scaler, rongeurs, and a No. 11 scalpel blade, were also unsuccessful.

Intraoperatively, the material demonstrated marked adhesion to the dura mater, significantly increasing the risk of iatrogenic spinal cord injury during manipulation. Pneumatic drilling was subsequently used in an attempt to fragment the mineralized material (debulking); however, because of the high risk of neural trauma, further aggressive removal of the residual material was avoided. Therefore, lateral enlargement of the ventral slot margins was performed to achieve functional decompression, defined as restoration of sufficient space for neural tissue without complete anatomical removal of all extradural material (Fig. 2).

In the immediate postoperative period, improvement in cervical mobility and posture was observed, along with resolution of pain upon cervical palpation. At the 30-day postoperative re-evaluation, the dog showed no neurological deficits, ambulated normally, maintained appropriate posture, and exhibited preserved cervical mobility without discomfort on epaxial palpation. At that time, the patient was still receiving pregabalin (4 mg/kg orally twice daily). Sixty days after surgery, all medications had been discontinued, and the dog remained neurologically normal without evidence of cervical myelopathy.

Postoperative follow-up

At the final follow-up evaluation, performed 20 months after surgery, repeat CT examination demonstrated persistence of the residual mineralized intervertebral disc material within the vertebral canal, without evidence of progression of the compressive lesion (Fig. 3). Despite the persistent imaging findings, the dog remained clinically asymptomatic, neurologically normal, and free of analgesic or anti-inflammatory medications.

Discussion and conclusions

This report describes the surgical management of cervical spinal cord compression caused by a severely mineralized intervertebral disc extrusion in a dog using a modified ventral slot technique. Intraoperatively, the extruded material exhibited an osseous-like consistency and marked adhesion to the dura mater, making surgical manipulation particularly challenging. Considering the close proximity of the lesion to critical structures, including the spinal cord and vertebral venous plexus, aggressive removal of the mineralized material was considered to carry a high risk of iatrogenic injury.

Therefore, a modified ventral slot procedure with lateral enlargement of the osseous window was performed to promote functional spinal cord decompression while minimizing manipulation of the adherent extradural material. This approach was associated with substantial postoperative neurological improvement and durable long-term clinical recovery.

Ventral slot decompression consists of creating a ventral osseous defect over the affected intervertebral space (18) and remains the standard surgical technique for Hansen type I cervical disc extrusions and cervical disc protrusions (3). Favorable postoperative functional outcomes have been widely reported following this procedure (9, 17). However, compared with surgical approaches involving other spinal regions, cervical spinal surgery carries a higher risk of severe complications and perioperative mortality (4).

Intraoperative complications associated with ventral slot procedures are primarily related to the intimate anatomical relationship between the cervical spinal cord and adjacent respiratory and cardiovascular structures. Reported complications include hypotension, hypoventilation, hemorrhage from the vertebral venous plexus, and incomplete spinal cord decompression (4). Additionally, injury to adjacent structures such as the recurrent laryngeal nerve and esophagus may occur. A previous report described iatrogenic

meningomyelopathy associated with attempts to remove extradural disc material firmly adherent to the dura mater in a chronic case of cervical intervertebral disc disease, resulting in severe intraoperative complications and patient death (19). These findings reinforce that aggressive manipulation of firmly adherent mineralized material represents a significant surgical risk.

In the present case, marked neurological improvement was observed despite the persistence of residual mineralized extradural material on follow-up CT performed 20 months after surgery. This finding suggests that complete anatomical removal of the disc material may not always be necessary to achieve sustained neurological recovery. Instead, reduction of spinal cord compression and restoration of adequate functional space for neural tissue may be sufficient for neurological improvement in selected cases.

Similarly, it has been shown that dogs with multiple cervical compressive lesions experienced clinical improvement in 97.5% of cases when ventral decompression was directed only to the lesion considered clinically most relevant (7). Favorable outcomes in dogs with residual non-operated compressive lesions further support the hypothesis that neurological improvement may be more closely associated with alleviation of spinal cord compression than with complete elimination of all extradural disc material.

Together, these findings support the concept of functional decompression, in which clinical recovery can occur despite persistent residual compression identified on postoperative imaging studies.

The literature describing cervical spinal cord compression caused by severely calcified intervertebral disc material in dogs remains limited, with only isolated reports available (5). In the present case, a possible association between disc mineralization and the calcinosis cutis diagnosed in the patient was considered. Calcinosis cutis is characterized by abnormal calcium deposition within soft tissues and is commonly associated with endogenous or iatrogenic hypercortisolism in dogs (13, 14). Although calcium deposition most commonly affects the dermis (9, 16), involvement of other tissues, including bone and gastrointestinal structures, has also been reported (15). Therefore, chronic corticosteroid administration may have contributed to abnormal calcium deposition within the extruded disc material in the present case. However, the pathophysiological mechanisms underlying this potential association remain poorly understood and require further investigation.

This report has several limitations. Histopathological confirmation of the mineralized material was not obtained because complete removal of the lesion was considered unsafe intraoperatively. Consequently, definitive characterization of the material was not possible. In addition, the limited number of reports describing cervical mineralized disc extrusions and their surgical management in veterinary medicine restricts direct comparison with previously published cases.

In conclusion, this report demonstrates that a modified ventral slot technique may provide effective functional spinal cord decompression in dogs with severely mineralized cervical intervertebral disc extrusion, even when complete removal of the extradural material is not feasible. In the present case,

avoidance of aggressive manipulation of disc material adherent to the dura mater was associated with sustained neurological improvement and long-term clinical stability.

Despite persistence of residual mineralized extradural material on follow-up CT examination, the dog remained neurologically normal 20 months after surgery. These findings suggest that clinical improvement may be achieved through adequate spinal cord decompression without complete anatomical removal of all mineralized disc material.

Declarations

Ethics approval and consent to participate

Ethical approval was not required for this study as it reports a single clinical case managed as part of routine veterinary care.

Consent for publication

Informed consent for publication of this case report was obtained from the dog's owner.

Competing interests

The authors declare that they have no competing interests.

Funding

Not applicable.

Author Contribution

V.C Malvessi and A. Mazzanti wrote the manuscript. V.C Malvessi and J.S Rauber provided neurological care. A.M.T Sekita and D.V Beckmann analyzed the tomographic images. L.T Mangini and P. Freisbelen performed the anesthesia. A. Mazzanti and V.C Malvesi performed the surgery. J.F.S Mielke and J.N.F Chaves assisted in the surgery. All authors have read and approved the final version of the manuscript.

Acknowledgements

This study was financially supported by the National Council for Scientific and Technological Development (CNPq), grant number 310969/2021-2, and by the Coordination for the Improvement of Higher Education Personnel – Brazil (CAPES), Finance Code 001.

Data Availability

Clinical data and images from this case report are available from the corresponding author upon reasonable request.

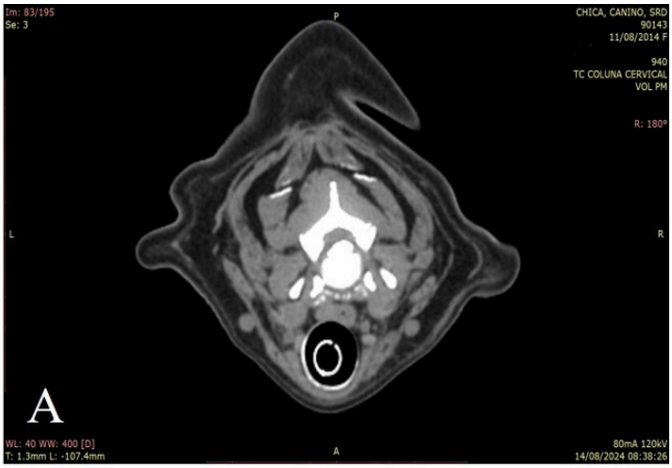
References

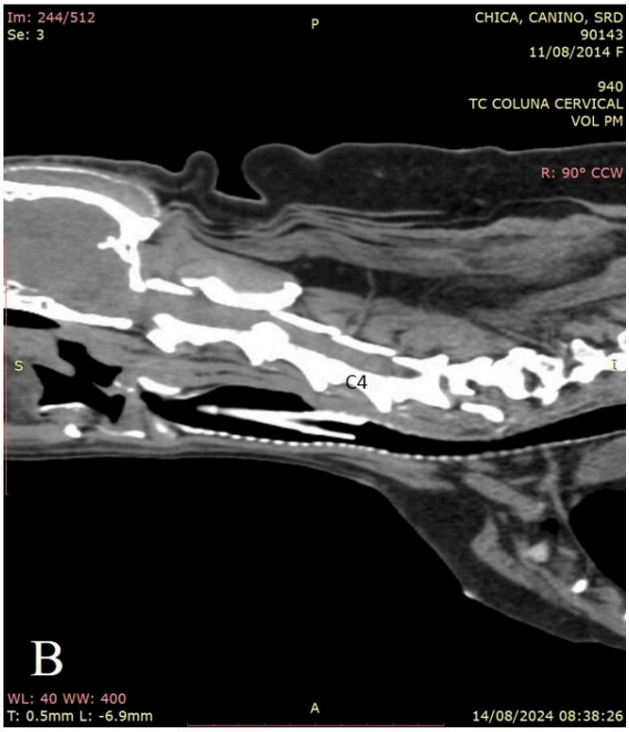
1. Brisson BA. Intervertebral Disc Disease in Dogs. Veterinary Clinics of North America. Small Anim Pract. 2010;40(5):829–58. 10.1016/j.cvsm.2010.06.001.
2. Stigen Ø, Ciasca T, Kolbjørnsen Ø. Calcification of extruded intervertebral discs in dachshunds: a radiographic, computed tomographic and histopathological study of 25 cases. Acta Vet Scand. 2019;61(1). 10.1186/s13028-019-0448-2.
3. Jensen VF, Ersboll AK. Mechanical Factors affecting the Occurrence of Intervertebral Disc Calcification in the Dachshund - a Population Study. J Vet Med Ser A. 2000;47(5):283–96. 10.1046/j.1439-0442.2000.00296.x.
4. Stigen Ø. Calcification of Intervertebral Discs in the Dachshund. A Radiographic Study of 327 Young Dogs. Acta Vet Scand. 1991;32(2):197–203. 10.1186/BF03547678.
5. Hansen HJ. A Pathologic-Anatomical Study on Disc Degeneration in Dog: With Special Reference to the So-Called Enchondrosis Intervertebralis. Acta Orthop Scand. 1952;23(sup11):1–130. 10.3109/ort.1952.23.suppl-11.01.
6. LIPTAK J, WATT P, THOMSON M. Hansen type I disk disease at T1-2 in a Dachshund. Aust Vet J. 1999;77(3):156–9. 10.1111/j.1751-0813.1999.tb11222.x.
7. Chang YP, Huang WH, Lua WZ, Wong W, Liu I-H, Liu CH. Outcomes in Dogs with Multiple Sites of Cervical Intervertebral Disc Disease Treated with Single Ventral Slot Decompression. 2023;10(6):377–7. 10.3390/vetsci10060377
8. Funkquist B, Svalastoga E. A simplified surgical approach to the last two cervical discs of the dog. The Journal of small animal practice [Internet]. 1979;20(10):593–601. Available from: https://pubmed.ncbi.nlm.nih.gov/513654/. 10.1111/j.1748-5827.1979.tb06667.x
9. DA COSTA RC. Ventral cervical decompression. In: SHORES A, BRISSON BA, editors. Current Techniques in Canine and Feline Neurosurgery. New Jersey: Wiley Blackwell; 2017. pp. 156–61. Cap.17.
10. Tan RM, Stern AW, White AG, Campbell KL, Novak K. Pathology in Practice. Calcinosis cutis. J Am Vet Med Assoc. 2013;243(3):347–9. https://doi.org/10.2460/javma.243.3.347.
11. WALSH J, FAIRLEY J. Cutaneous mineralization and ossification. In: Goldsmith L, Katz S, Gilchrest B, et al. editors. Fitzpatrick's Dermatology in General Medicine. 5th ed. New York: McGraw-Hill; 1999. pp. 1829–35.
12. Khodakaram Tafti A, Hanna P, Bourque AC. Calcinosis Circumscripta in the Dog: A Retrospective Pathological Study. Journal of Veterinary Medicine Series A-physiology Pathology. Clin Med.

2005;52(1):13–7. 10.1111/j.1439-0442.2004.00675.x.

13. Miller MA, Zachary JF. Mechanisms and Morphology of Cellular Injury, Adaptation, and Death. Pathologic Basis of Veterinary Disease [Internet]. 2017;2–43.e19. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7171462/
14. Miller WH, Griffin CE, Campbell KL, Muller GH, Scott DW. Muller & Kirk's small animal dermatology. 7 ed. St. Louis, Mo.: Elsevier; 2013.
15. Berry CR, Ackerman N, Monce K, PULMONARY MINERALIZATION IN, FOUR DOGS WITH CUSHING'S SYNDROME. Vet Radiol Ultrasound. 1994;35(1):10–6. https://doi.org/10.1111/j.1740-8261.1994.tb00170.x.
16. Walsh J, Fairley J. Cutaneous mineralization and ossification. Fitzpatrick's dermatology in general medicine. 5th ed. New York (NY): McGraw-Hill; 1999.
17. Schwab ML, Ferrarin DA, Ripplinger A, Herculano LFS, Colvero ACT, Wrzesinski MR et al. Ventral slot in the clinical recovery of dogs with lateralized compression as a result of cervical intervertebral disc disease – 20 cases (2008–2018). Ciência Rural. 2020;50(8).
18. Dewey CW. Cirurgia da coluna cervical. Fossum TW. Cirurgia de Pequenos Animais. 5 ed. Rio de Janeiro: GEN Guanabara Koogan; 2021. Chapter 40.
19. Araújo BM, Silva LM, Fernandes ACM, Tudury EA. Lesão iatrogênica meningomedular em um cão submetido à espondilectomia ventral para tratamento de extrusão crônica de disco intervertebral cervical. Arq Bras Med Vet Zootec. 2013;65(3):649–53.

Figures





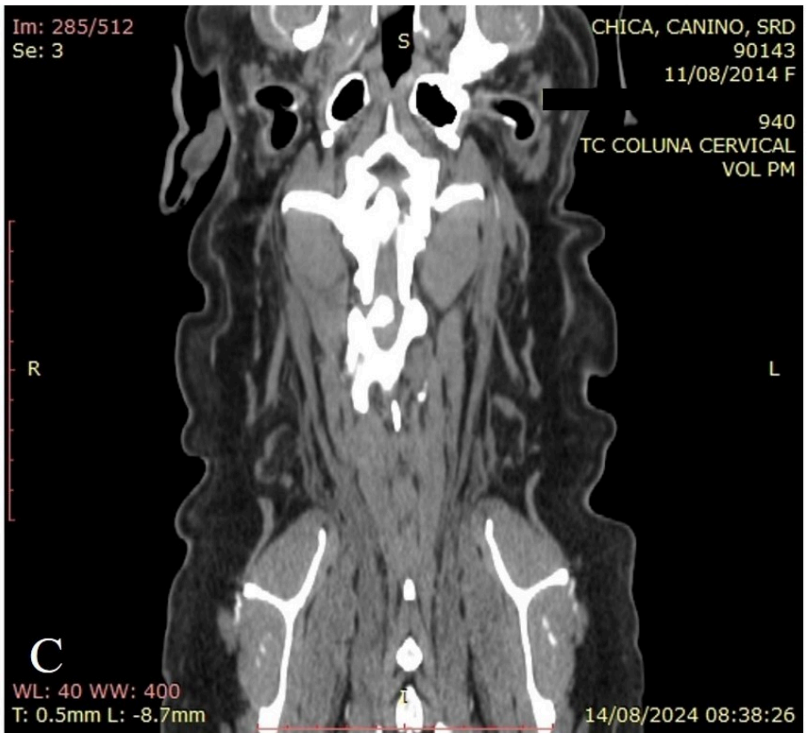


Figure 1

Preoperative computed tomography demonstrating extramedullary compression caused by extrusion of the calcified intervertebral disc between the C2–C3 vertebrae. Transverse plane (A); sagittal plane (B); dorsal plane (C).

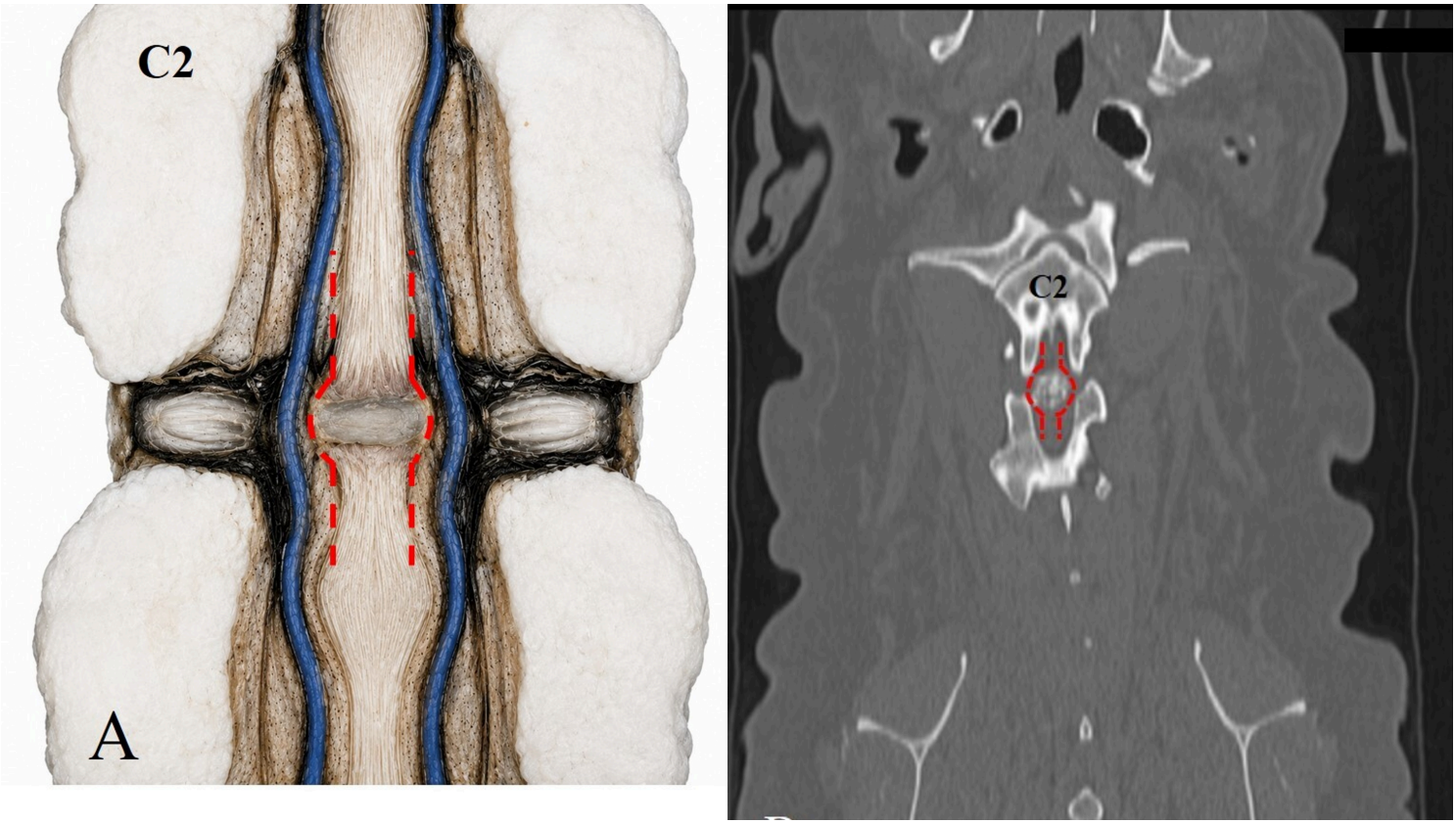


Figure 2

Schematic representation (A) of the modified ventral slot with enlargement (dotted lines) around the extruded disc material in an attempt to relieve pressure on the spinal cord. In (B), the patient's computed tomography in the dorsal plane is shown.

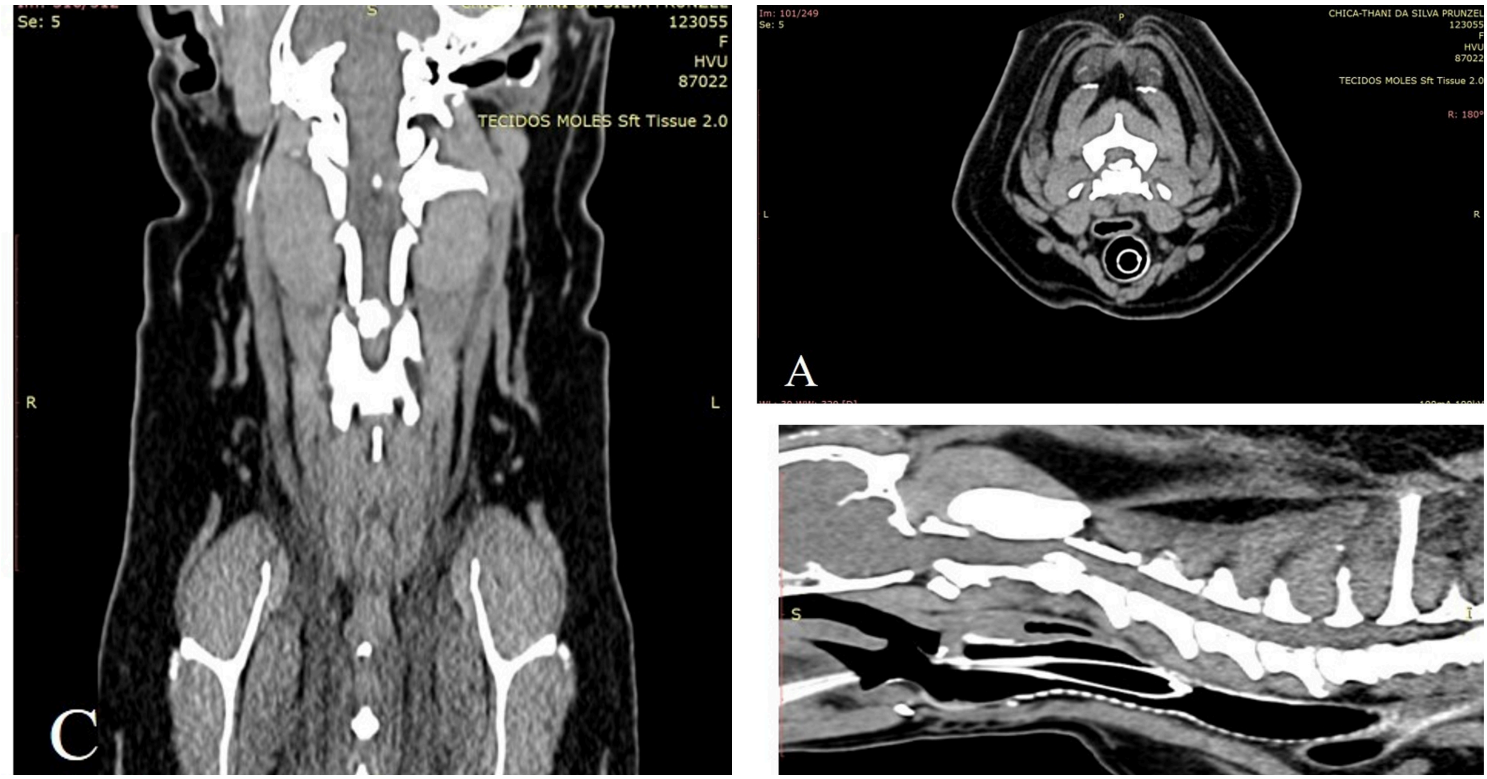


Figure 3

Computed tomography of the dog 20 months after the surgical procedure. Persistent extramedullary compression caused by extrusion of the calcified intervertebral disc between the C2–C3 vertebrae can still be observed. The disc material remained practically unchanged in volume compared to the preoperative examination. Transverse plane (A); sagittal plane (B); dorsal plane (C).