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Distraction-stabilisation of two adjacent intervertebral spaces in a Dalmatian dog with caudal cervical spondylomyelopathy

J. Beranek[1], A. Tomek[2], D. Lorinson[3]

[1]Rutland House Referrals, St Helens, United Kingdom, [2]Klinika JAGGY s.r.o., Brno, Czech Republic, [3]Chirurgische Überweisungspraxis, Vösendorf, Austria

Summary

A 4-year-old, 40-kg, male, entire Dalmatian was presented for evaluation of chronic neck pain and pelvic limb ataxia. Myelography revealed ventrodorsal (hourglass) extradural compression over the intervertebral space between the 5th and 6th cervical vertebra and ventral extradural compression between the 6th and 7th cervical vertebra. Cranial compression disappeared and caudal compression markedly diminished after performing cervical traction. MRI scan confirmed protrusion of intervertebral discs and spinal cord compression in previously mentioned intervertebral spaces. Surgical distraction-stabilization of both intervertebral spaces was performed using threaded pins and polymethylmethacrylate. The convalescence from surgery was uneventful and the dog was walking without any signs of paresis until 5 months after surgery when radiography revealed implants loosening. The dog recovered fully of the implant removal and remained asymptomatic for more than 30 months.

Keywords: distraction-stabilization, caudal cervical spondylomyelopathy, polymethylmethacrylate

Distraktion und Stabilisierung von zwei angrenzenden Intervertebralräumen bei einem Dalmatiner mit kaudaler zervikaler Spondylomyelopathie

Ein 4-jähriger Dalmatinerrüde von 40 kg Körpergewicht wurde aufgrund chronischer Halswirbelsäulenschmerzen und Ataxie an beiden Hinterextremitäten vorgestellt. Die Myelographie ergab eine ventrodorsale extradurale Kompression zwischen dem 5. und 6. Halswirbel sowie eine ventrale extradurale Kompression zwischen dem 6. und 7. Halswirbel. Durch zervikalen Zug verschwand die kraniale Kompression, die kaudale Kompression wurde dadurch deutlich vermindert. Das MRI bestätigte die Bandscheibenprotrusionen und Rückenmarkskompressionen in den oben angeführten Zwischenwirbelbereichen. Eine chirurgische Distraktion und Stabilisation erfolgte in beiden Intervertebralräumen mit Schrauben und Polymethylmethacrylat. Der unmittelbare postoperative Verlauf war unauffällig. Bei der klinischen Kontrolle 5 Monate nach dem Eingriff war der Hund gehfähig ohne klinische Anzeichen einer Parese oder Ataxie. Die radiologische Kontrolle ergab jedoch eine Implantatlockerung. Nach Entfernung aller Implantate erholte sich der Hund vollständig und blieb 30 Monate symptomfrei.

Schlüsselwörter: Distraktion, Stabilisation, kaudale zervikale Spondylomyelopathie, Polymethylmethacrylat

Introduction

Caudal cervical spondylomyelopathy (wobbler syndrome) has been recognised as a common disease in Doberman Pinchers, Great Danes and other large breeds (Chambers, 1977; Denny, 1977). Spinal cord compression in older Doberman Pinchers is a degenerative multifactorial condition involving vertebral instability, chronic degenerative disc disease, hypertrophy of dorsal longitudinal ligament and hypertrophy of interarcuate ligament (Seim, 1982). Variable degree of spinal cord compression during flexion and extension of the neck has been dem-

onstrated by myelography. CT myelography was used in diagnosis of cervical spondylomyelopathy in one study of 58 dogs (da Costa, 2011) and CT myelogram scans in neutral and traction positions of the neck were used to determine dynamic component of compression (Adrega da Silva, 2010). Linear traction applied to the cervical spine may result in a significant relief of spinal cord compression (Seim, 1982) whereas the static components involved can be evaluated using MRI (da Costa, 2006; Lipsitz, 2005). Variable methods of surgical management have been presented with different postoperative morbidity and long-term outcome (Jeffery, 2001). Traction responsive compression of the spinal cord can be treated by a distraction-stabilisation technique (Ellison, 1988; Bruecker, 1989; Dixon, 1996). Literature evidence of surgical techniques is particularly focused on cases with a single compression (Bruecker, 1989; Queen, 1998; Steffen, 2011; Adamo, 2011). The majority of studies only reported dogs with two adjacent compressions together with dogs having just a single lesion (Dixon, 1996; McKee, 1999). Recently, surgical treatment addressing two intervertebral spaces of disc-associated wobbler syndrome in 7 dogs was published using distractible titanium cage (De Decker, 2011). Studies (Ellison, 1988; Marchevsky, 1999) reportig the use of PMMA bridging over two adjacent intervertebral spaces are rare with only a small number of dogs. The purpose of this case report is to show the long-term results of a modified distraction-stabilisation technique used to stabilize two adjacent intervertebral disc spaces in a Dalmatian.

History and clinical examination

A 4-year-old, 40-kg, male, entire Dalmatian was presented for evaluation of neck pain and pelvic limb ataxia. Three weeks of stiffness after rest and wobbling of hind limbs getting worse after exercise and stair climbing were reported by the owner. The dog was obese. Gait observation showed mild generalized ataxia; pelvic limbs were apparently more ataxic compared to thoracic limbs. Circumduction and dragging of the nails were noticed during the movement of the left pelvic limb. The dog was standing with his pelvic limbs wide apart. The postural reactions were classified as hypermetric in both pelvic limbs. The withdrawal reflexes of both thoracic limbs were mildly weak. The withdrawal reflexes of pelvic limbs were normal bilaterally; the patellar reflex was slightly increased bilaterally. Cranial nerve responses were normal. The dog showed a remarkable painful response on extension and left lateral flexion of the neck. Following results from the neurological examination, a spinal cord lesion corresponding to deep cervical C5-T2 localization was suspected. The results from the orthopaedic examination were unremarkable. Following the discussion with the owner about the list of differential diagnoses, the dog was admitted for diagnostic imaging.

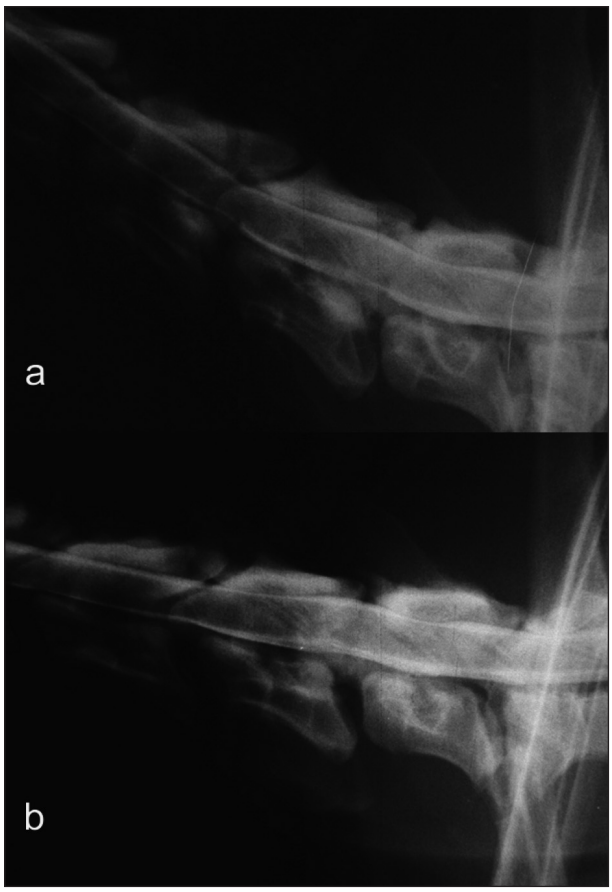

Figure 1: Lateral cervical radiographs after myelography in neutral position (a) and during traction (b). Note that hourglass compression C5/6 disappeared during the traction.

Diagnostic imaging

The dog was premedicated with 8 mg diazepam (Apaurin, Krka) and 8 mg butorphanol (Butomidor, Richter Pharma) given intravenously. General anaesthesia was induced with propofol (Propofol, Fresenius) given to effect and maintained with isoflurane in an oxygen gas carrier. Following plain radiography, cervical myelography was performed after cisternal application of 8 ml of iomeprolum (Iomeron, Bracco). Radiography revealed ventrodorsal (hourglass) extradural compression located over the intervertebral disc space between the fifth (C5) and sixth (C6) cervical vertebra and ventral extradural compression located over the intervertebral disc space between C6 and C7. Cranial C5/6 compression disappeared and caudal C6/7 compression markedly diminished during cervical traction. MRI scan revealed degenerative changes and protrusion of intervertebral discs of C5/6 and C6/7. The spinal cord was compressed at both previously mentioned intervertebral spaces. Recovery from general anaesthesia was uneventful and the dog was hospitalized until surgical stabilization.

Surgical technique

Surgical distraction/stabilization of C5/6 and C6/7 intervertebral spaces was performed six days later. The dog was premedicated with 8 mg midazolam (Dormicum, Roche) and 8 mg morphine (Morphin, Biotika) given intravenously. General anaesthesia was induced with propofol (Propofol, BBraun) given to effect and maintained with isoflurane in an oxygen gas carrier. Cefazoline (800 mg, Cefazoline, Sandoz) was administered intravenously 30 minutes before surgery. The dog was positioned in dorsal recumbency with the neck supported in a vacuum pad in mild extension. The ventral cervical and cranial thoracic area were prepared for the surgery. Ventral midline approach to the caudal cervical spine was performed. C5/6 and C6/7 intervertebral spaces were identified using a markedly prominent C6 transverse process. Disc fenestration was performed in affected intervertebral spaces C5/6 and C6/7. Following fenestration, a short recess was drilled into the vertebral endplates using pneumatic burr to allow insertion of vertebral distractors. Two large Gelpi self-retaining retractors were placed one by one in predrilled slots of each intervertebral space (C5/6 and C6/7) and used as vertebral distractors. Pointed tips of the retractors burrowed slowly in a cancellous bone of vertebral bodies during gradual vertebrae distraction. Positive threaded cortical pins (Medium Interface, 4.0 mm, Imex Veterinary Inc.) were introduced into vertebral bodies of C5, C6 and C7 after pre-drilling with 3.1 drill bit. Drilling was performed slowly with a gradual measurement of drill advancement to prevent penetration into the spinal canal. Limits for drilling were premeasured from plain radiographs and radiographic magnification was corrected. Two divergent pins were placed into each vertebral body crossing each other. The sharp tips of the pins were cut off before placement. The distracted position of vertebras was temporarily stabilized with external skeletal fixation clamps and rods applied on pin shafts on both sides. Gelpi retractors were removed and polymethylmethacrylate (PMMA) with gentamycin (Palacos R+G, Heraeus Medical) was placed on the ventral side of the vertebral bodies C5-C7. Special care was taken to safely incorporate all the pins. PMMA was flushed thoroughly during polymerisation to diminish the heating effect on the vertebral bodies and surrounding soft tissues. Temporary external fixation devices were removed and pin shafts were cut off close to PMMA. Wound closure was performed routinely. Postoperative radiography revealed the pins purchased adequately in the vertebral bodies without penetration to the spinal canal. The width of both distracted intervertebral spaces (C5/6 and C6/7) in postoperative lateral radiograph was compared with preoperative plain and traction myelography radiographs. C5/6 and C6/7 intervertebral spaces were the same or larger in postoperative radiograph compared with the traction myelography and markedly larger compared with the plain radiograph. The length of C6 vertebral body was used as a reference to correct possible differences related to animal positioning. The recovery from general anaesthesia was uneventful and the dog was ambulatory next day after surgery. Pain medication continued with 8 mg morphine (Morphin, Biotika) given every 6 hours subcutaneously for 2 days following the surgery. Antibiotic therapy – cefadroxil (Cefa Cure, Intervet) was administered for 10 days following the surgery.

Figure 2: Lateral postoperative radiograph of the neck. Implants did not penetrate the spinal canal and were deeply positioned in vertebral bodies. Implants maintained distraction of the intervertebral spaces C5/6 and C6/7.

Postoperative care

The dog was discharged 3 days after the surgery with only mild ataxia of the pelvic limbs. He was able to carry the neck and the head in a normal position and to shake his head and neck without any painful response. Weight reduction and exercise restraint were advised.

Five months later, the dog was presented for re-examination. The dog had lost 3 kg of his bodyweight. The owner reported that the dog had developed difficulties with swallowing food recently and had showed neck stiffness for 1 day prior to presentation. Neurological examination did not reveal remarkable deficits of the dog's gait or stance. Follow up radiography under short sedation revealed implant loosening from C6 and C7. Marked spondylotic reaction was revealed ventrally on the vertebral bodies growing over the intervertebral spaces of the previously stabilized vertebras. The intervertebral spaces maintained the same width compared with the findings on the postoperative radiographs. Removal of the implants was advised and surgery was performed under general anaesthesia the next day. The fibrous capsule around the implants was incised and a small amount of serous fluid was found surrounding PMMA. Direct cytology from the fluid did not suggest any infection. Four of the caudal pins were freely movable. PMMA was cut off from the cranial pins and removed. Two remaining cranial pins were screwed out from the vertebral body and removed. The wound was thoroughly flushed and closed.

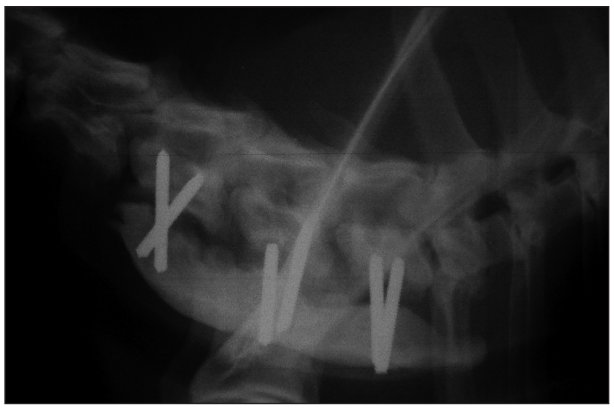

Figure 3: Lateral cervical radiograph 4 moths after surgery. Note implants loosening from vertebral bodies C6 and C7. Ventral spondylotic reaction between C6 and C7 is visible.

Recovery from general anaesthesia was uneventful and the dog was ambulatory within a few hours after surgery. Pain medication was continued 24 hours following surgery and the dog was discharged the next day after the implant removal.

The follow-ups were performed 8 and 30 months after the first surgery. The dog was presented with a normal stance and gait and was able to carry his neck and head in a normal upright position. Food swallowing and the level of exercise were reported as normal by the owner.

Discussion

Various techniques addressing different surgical instruments or methods used to distract vertebrae during surgery in dogs with two adjacent intervertebral spaces affected have been reported. Distraction of the vertebrae was achieved by combining Gelpi retractor with a bone spreader anchored in vertebral bodies in a study of 9 dogs treated with PMMA plugs (Dixon, 1996). The distraction was accomplished by the assistant performing the traction on the neck in a study of 2 dogs stabilized with screws and PMMA (Ellison, 1988) and a case report of Rottweiler dog stabilized with interbody PMMA (Marchevsky, 1999). Vertebral distraction in a study of 19/78 dogs having compressive lesions at two sites was achieved by a vertebral distractor corresponding to the size of the intervertebral washer (McKee, 1999). Two standard large Gelpi retractors were used to distract both intervertebral spaces simultaneously in our case report. Pointed tips were easily anchored in limited slots that had been drilled in vertebral end plates after disc fenestration. Achieved distraction of the intervertebral spaces was found equal or larger in the postoperative radiograph compared to preoperative traction myelography. Additionally the use of standard surgical equipment for vertebral distraction can decrease the cost of surgery. The extent of distraction performed and maintained with instruments inserted directly into intervertebral spaces should be more reliable and better measurable compared with non-specific manual traction performed by an assistant. However, the limits of optimal vertebral distraction have not been justified in any previous study. The Gelpi retractor was force opened by the surgeon's maximal strength. Excessive distraction may increase an overall length of three fused vertebral bodies and can contribute to a higher risk of domino effect in adjacent intervertebral spaces.

Instruments holding the vertebrae in a distracted position can compromise the application of stabilizing PMMA around pins. Temporary external fixator clamps and rods were therefore used to maintain the vertebrae in a distracted position. Application of the external fixator allowed removal of the Gelpi retractors without a risk of collapse of previously distracted intervertebral spaces. It did not occupy any space ventrally to the vertebral bodies and the placement of PMMA around the implants was not affected.

Cancellous bone graft insertion is widely recommended as part of distraction-stabilization surgical techniques to achieve a complete fusion of affected vertebrae (Bruecker, 1989; Jeffery 2001; Steffen, 2011). Bone grafting applied on ventral vertebral bodies resulted in complete or nearly complete bone fusion 1–2 months following surgery in a study of 9 dogs stabilized with PMMA plugs inserted in two adjacent intervertebral spaces (Dixon, 1996). The distracted width of two intervertebral spaces was stabilized with the cortical bone graft harvested from the iliac bone in a study reviewing stabilization with screws and PMMA (Ellison, 1988). Bone grafting was not used in the presented case report for several reasons. Bone graft harvesting and manipulation were considered a risk factor of PMMA infection (Liska, 2000). The increasing temperature during PMMA polymerization may limit vitality and survival time of cancellous graft cells potentially used in intervertebral spaces (Belkoff, 2003). Long term clinical outcome was not affected in retrospective case series evaluating surgical treatment of atlantoaxial instability where bone graft was not placed between two vertebral bodies (Jeserevics, 2008). Bone graft harvesting may prolong surgical time and can increase postoperative morbidity.

Rigid surgical fixation of affected vertebrae does not mimic the behaviour of intact cervical spine. In a cadaveric study of large breed dogs Pin-PMMA specimens stabilized in one intervertebral space allowed significantly less motion than specimens with intact vertebrae (Adamo, 2007). The stress created during spontaneous neck movement applied on bridging implants can be even higher when stabilization has been performed over two vertebral spaces. Use of positive profile threaded pins may lower the incidence of pins loosening or implant failure (Koehler, 2005). Two intervertebral spaces were stabilized using screws and PMMA in a study of two dogs (Ellison, 1988). Both of the dogs developed implant loosening. A fracture of PMMA led to deterioration of neurological status and the first dog was euthanized one month after the surgery. Early screw pull-out of the implant was

reported in the second dog. The dog survived but neurological recovery was not complete. Implant loosening was found in the presented case 5 months after the surgery causing mild clinical signs of neck stiffness and swallowing difficulties. The loose implant was removed but the position of distracted vertebras and intervertebral space width remained unaffected. It is difficult to make a conclusion based on results from a few dogs only but distraction-stabilization over two adjacent intervertebral spaces using bridging PMMA may be a surgical technique with a higher risk of implant failure. Use of positive profile threaded pins may prolong the time of temporary stabilization. The intervertebral spaces maintained in the distracted position for a sufficient period of time may prevent spinal cord compression after implant loosening.

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Corresponding author

MVDr. Jan Beranek MRCVS
Rutland House Referrals
Abbotsfiels Road
St Helens WA94HU
United Kingdom
Tel.: +44 (0)1744853510, +44 (0)7984652077
Fax: +44 (0)1744853511
beranek35@seznam.cz

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