

# Surgical Treatment of Lumbosacral Discospondylitis with Gentamicin-Impregnated Polymethylmethacrylate Cement and Omentalization

Maria Manou<sup>1,2</sup> Aurélien Jeandel<sup>1,3,4</sup> Stéphane Blot<sup>1,3</sup> Pierre Henri Moissonnier<sup>1,5</sup>

<sup>1</sup> Small Animal Surgery and Neurology Departments, National Veterinary School of Alfort (ENVA), UPEC, Maisons-Alfort, France

<sup>2</sup> Small Animal Surgery Department, School of Veterinary Medicine, University College Dublin, Dublin, Ireland

<sup>3</sup> L'Institut Mondor de Recherche Biomédicale (IMRB, U955 Inserm), UPEC, France

<sup>4</sup> Neurology Department, CHV Pommery, Reims, France

<sup>5</sup> Surgery Department, National Veterinary School of Lyon (ENVL), Marcy-l'Étoile, France

**Address for correspondence** Maria Manou, DVM, University Veterinary Hospital, School of Veterinary Medicine, University College Dublin, Belfield, Dublin 4, Dublin, Ireland (e-mail: marmanou30@gmail.com).

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## Abstract

**Objective** The aim of this study was to describe a novel technique using a gentamicin-impregnated polymethylmethacrylate (PMMA) plug for the surgical treatment of lumbosacral discospondylitis with concomitant instability.

**Clinical Report** A 7-year-old male German Shepherd dog with lumbosacral (LS) discospondylitis and previously diagnosed with degenerative lumbosacral disease underwent ventral slot and distraction of the L7 to S1 intervertebral space with a gentamicin-impregnated PMMA plug. The lumbosacral joint was accessed via the abdomen. Samples were collected for bacterial culture and sensitivity, fungal culture and histopathological examination. The surgical site was omentalized. Long-term oral antimicrobials were administered.

**Results** Clinical improvement was seen immediately after surgery. Complete return to previous activity level was observed 12 months after surgery. Follow-up radiographs 18 months after the procedure revealed no implant migration.

**Clinical Significance** The gentamicin-impregnated PMMA plug in addition to the surgical debridement seemed to be an effective way for short-term distraction, potentially contributing, along with the appropriate antimicrobial therapy and analgesia, to alleviation of pain immediately after surgery and providing for a good short-term outcome, in this clinical case. The use of cement plugs as sole devices in the LS joint warrants further study.

## Keywords

- dog
- lumbosacral discospondylitis
- ventral slot
- gentamicin-impregnated PMMA plug
- omentalization

## Introduction

Lumbosacral (LS) discospondylitis is an infection of the L7 to S1 intervertebral disc and the L7 and S1 vertebral endplates.<sup>1</sup> Degeneration, which typically occurs at the LS junction,<sup>2</sup> might facilitate the implantation of blood-borne microorganisms originating from distant sites of infection (urogenital tract, oral cavity, skin etc). Abscesses near the LS joint, foreign body migration and open wounds are other causes of

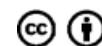
discospondylitis. Once discospondylitis is established, the increased mobility of the LS joint increases bacterial diffusion, and spontaneous healing may be compromised.<sup>3</sup> Pain, lameness and neurological signs are commonly reported.<sup>4</sup> Diagnosis is based on history, physical examination, laboratory and diagnostic imaging findings. Medical treatment alone is ineffective in some cases, especially when infection is associated with instability and compression of the cauda equina and nerve roots.<sup>3</sup> Several stabilization systems have

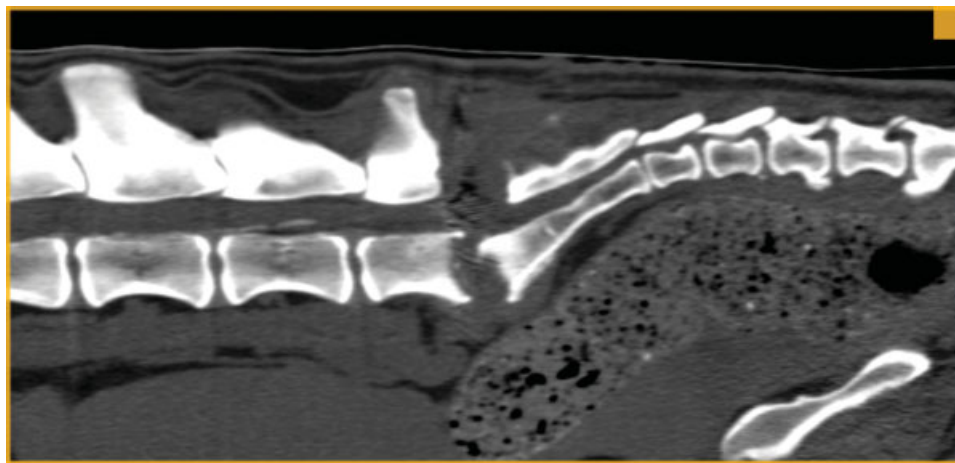
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**Fig. 1** Sagittal computed tomography image of the vertebral column. Caudal L7 and cranial S1 end plate lysis and ventral subluxation of S1. Soft tissue attenuating material ventral to the L7 to S1 intervertebral disc space.

been used to accelerate the healing process and ensure LS joint fusion, combined with decompressive dorsal laminectomy and/or partial or total discectomy, for dogs suffering from degenerative LS stenosis.<sup>5–13</sup> When discospondylitis is present, antibiotic medications can be added into polymethylmethacrylate (PMMA) cement or beads, or into sponges, to locally control the infection.<sup>14,15</sup> There are few reports in the veterinary literature documenting surgical treatment of LS discospondylitis.<sup>3,14</sup> This report describes the surgical treatment of LS discospondylitis in a dog using an original technique: ventral slot and gentamicin-impregnated PMMA implant.

## Case Description

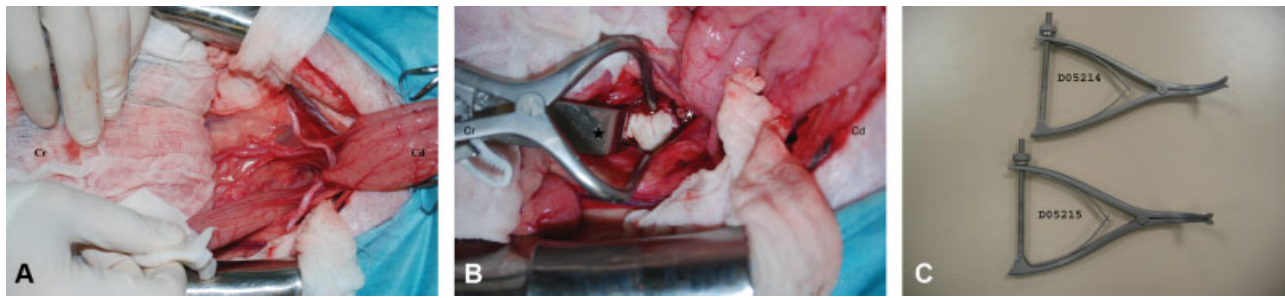
A 7-year-old, 35 kg, entire male German Shepherd dog was presented at Small Animal Hospital of the National Veterinary School of Alfort (ENVA) with an acute episode of reluctance to stand and walk. The dog had been presented in another referral centre, 6 weeks prior to presentation to our clinic, with a 10-week history of yelping episodes and left hindlimb lameness. A degenerative LS disease with disc protrusion and LS discospondylitis was diagnosed, based on caudal L7 vertebral endplate lysis evidenced on computed tomography (CT) scan (flexed/extended views) and spinal empyema identified intraoperatively. The dog was treated with dorsal laminectomy (Funkquist type B), and stabilization with transarticular facet screws. Medical treatment started at the time of surgery included amoxicillin–clavulanic acid (20 mg/kg PO, every 12 hours\*), tramadol (3 mg/kg, every 8 hours), carprofen (4 mg/kg PO, every 24 hours) and gabapentin (5 mg/kg PO, every 12 hours). Neurological improvement was initially reported. However, clinical deterioration occurred after antibiotic medications were discontinued 6 weeks after surgery. Physical examination on admission revealed pyrexia (39.5°C). Neurological examina-

tion showed general proprioceptive ataxia of the hindlimbs, conscious proprioceptive deficits in both hindlimbs, and LS pain on palpation. Spinal reflexes were normal in all four limbs. Haematology and biochemistry profiles were unremarkable. Blood culture was submitted. A CT scan (Brilliance CT 64 Channel; Philips, Suresnes, France) was performed. Aggressive osteolytic lesions of the caudal and cranial vertebral endplates of the L7 and S1 vertebrae, respectively, osteoproliferative lesions at the L7-S1 space, and the ventral aspect of the vertebrae and ventral displacement of the sacrum relative to the L7 vertebra (→Fig. 1) were observed. Clinical signs and imaging findings were suggestive of active LS discospondylitis and associated instability. Ultrasound-guided fine-needle aspiration (FNA) of the intervertebral space (dorsal approach, through laminectomy defect) and urine obtained by cystocentesis were submitted for bacterial culture and sensitivity testing. Revision surgery was undertaken to debride, sample, locally treat the infection, and distract the LS joint.

## Surgical Procedure

The dog was positioned in dorsal recumbency. The ventral surface of the LS joint was accessed as previously described by O’Riordan and colleagues.<sup>16</sup> The urinary bladder was expressed and retracted caudally. The median sacral artery and left sacral vein were ligated with polydioxanone. The anatomy of the L7 and S1 vertebrae was severely changed, and new tissue formation was seen. Infected and necrotic soft tissues and bone were removed with a 4 mm burr, and disc fenestration was performed. Samples (soft tissue, bone and intervertebral disc) were submitted for bacterial culture and sensitivity, fungal culture and histopathological examination. A ventral slot was performed to the floor of the vertebral canal. The width of the slot represented approximately one half of the width of the L7 and S1 vertebrae. The length of the slot was not greater than 33% of the length of the bodies. Two-thirds of the length occupied the caudal L7 and 1/3 the cranial S1 vertebrae, centred over the caudal third of the L7. The surgical site was flushed. The omental branches

\* Culture and sensitivity testing were reported to have been performed, at the referral practice. However, the results were not communicated to the authors of the study.



**Fig. 2** (A) Intraoperative image. The urinary bladder is emptied and retracted caudally to expose the ventral aspect of the lumbosacral joint. The colon is positioned laterally to the left to expose the joint (here retracted to the right). (B) Intraoperative image. The polymerized polymethylmethacrylate plug positioned at the L7/S1 intervertebral space, after ventral slot and distraction of the space. A Farabeuf retractor (black asterisk) protects the medial iliac artery. The medial sacral artery is ligated (asterisk). A Gelpi retractor is used to facilitate exposure. The descending colon is positioned against the left lateral abdominal wall and the urinary bladder is retracted caudally. (C) Moissonnier vertebral retractors. Two sizes are displayed. Abbreviations: Cd, caudal; Cr, cranial.

of the right gastroepiploic artery were ligated (bipolar electrocautery). A part of the splenic portion of the greater omentum was cauterized, preserving the gastrosplenic ligament, until ensuring adequate length of the omental flap. The flap was kept moistened in laparotomy swabs. Two holes were drilled (4 mm) at the cranial third of the L7 vertebra and caudal third of the sacrum. The tips of the limbs of a vertebral retractor (Moissonnier vertebral retractor; VetAncilla, France) (→Fig. 2C, ref D05215) were inserted in each hole. The arms of the retractor were progressively opened, and the LS space was distracted. The PMMA liquid preparation was impregnated with 1 mL of gentamicin 4% (1.143 UI/kg) and placed under continuous irrigation to prevent thermal injury of the surrounding tissues from the exothermic reaction of the cement (→Fig. 2). Once the cement solidified, the retractor was removed. The omentum was sutured to the soft tissues surrounding the LS space with polydioxanone (simple interrupted pattern). The coeliotomy incision was closed routinely. Castration was performed.

Postoperative radiographs showed proper placement of the implant within the intervertebral space. Recovery from anaesthesia was uneventful.

Histopathological examination revealed moderate chronic pyogranulomatous inflammation and fibrosis of the annulus fibrosus. Fungal culture was negative. Blood and tissue sample cultures were positive for *Staphylococcus pseudintermedius*, which was sensitive to marbofloxacin, cephalexin and gentamicin. Bacterial culture of urine and intervertebral space FNAs was negative. During the first 24 hours after surgery, methadone (0.2 mg/kg intravenous [IV] every 4 hours) and ketamine (2 µg/kg/h IV constant rate infusion) and meloxicam (0.1 mg/kg IV, every 24 hours) and marbofloxacin (2 mg/kg IV, every 24 hours) were given. The dog was discharged 48 hours after surgery with paraparesis, delayed correction response of the left hindlimb and mild LS pain on spinal palpation. Medical treatment at discharge included marbofloxacin (2 mg/kg PO, every 24 hours), meloxicam (0.1 mg/kg PO, every 24 hours) and gabapentin (8.5 mg/kg PO, every 8 hours).

Clinical examination was performed weekly during the first month, then monthly during the next 5 months, and then every 6 months until the latest follow-up at 18 months after surgery. Difficulty in rising was reported by the owner

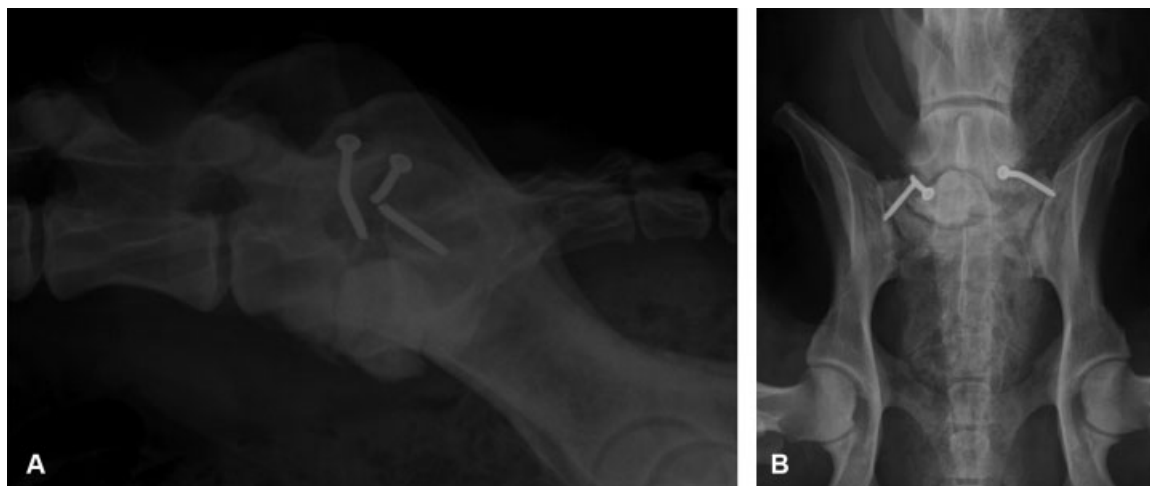
during the first recheck (7 days after surgery). Cephalexin (15 mg/kg PO, every 12 hours) was added. Antibiotic medications were administered for 5 months, with marbofloxacin being discontinued at 2.5 months after surgery. Gabapentin (8.5 mg/kg PO BID) was given for 2.5 months after surgery. Intermittent pelvic limb lameness was reported by the owner, during the 6 months following surgery, responding to tramadol administration (3 mg/kg PO, every 12 hours). Neurological examination at the 12- and 18-month follow-up revealed normal gait, inconsistent delayed conscious proprioception in the left hindlimb without pain or discomfort on palpation of the LS joint. The dog had returned to normal activity 12 months after the procedure.

Radiographs obtained at 1, 6 (→Fig. 3), 12 (→Fig. 4) and 18 months after surgery revealed no collapse of the intervertebral space, compared with the immediate postoperative radiograph, and the PMMA implant position remained unchanged, and without protruding dorsally into the vertebral canal. There were no signs of vertebral fusion, but new bone was progressively increasing at the ventral aspects of L7 and S1 vertebral bodies surrounding ventrally the plug, at the 6- and 12-month follow-up (→Figs. 3 and 4). No radiographic signs of infection were detected. At the 18-month follow-up, the radiographic findings were unchanged.

## Discussion/Conclusion

To our knowledge, this is the first clinical report that describes access to the LS joint via the abdominal cavity, followed by ventral slot and distraction of the intervertebral space, with the use of a gentamicin-impregnated PMMA plug. We elected this approach to directly access the ventral aspect of the L7 and S1 vertebrae, where lesions were more severe, aiming for accurate and sufficient sampling, and to institute appropriate antibiotic treatment. We decided not to further explore the dorsal compartment of the LS joint, to avoid disruption of scar tissue from the previous surgery and possible iatrogenic trauma and/or secondary infection to the cauda equina.

Several intervertebral devices, such as spacers, cages, bolts and PMMA plugs, have been used to distract several intervertebral segments.<sup>17–21</sup> The use of distractable titanium cages and PMMA plugs in the cervical vertebrae is described in *in vivo*



**Fig. 3** (A) Polymethylmethacrylate plug location on lateral radiographical view at 6 months after surgery. Implant failure, with breakage and bending of the transarticular screws, previously positioned. Mineralized material at the ventral caudal and cranial aspect of the L7 and S1 vertebrae, respectively. The position of the implant remains unchanged. (B) Ventrodorsal view.



**Fig. 4** (A) Polymethylmethacrylate plug location on lateral radiographical view at 12 months after surgery. The mineralized material is still present with progressive expansion, surrounding ventrally the implant. (B) Ventrodorsal radiographical view.

studies; despite initial promising results, the techniques showed implant related complications, adjacent segment disease and high overall mortality rate at long-term.<sup>20,21</sup> In a biomechanical study, insertion of a sole titanium cage restored or increased the disc height, opening the foraminal apertures and providing stability of the LS space.<sup>18</sup> Intervertebral spacers were reported to reduce space collapse in cervical vertebrae after disc fenestration *in vitro*, but stability of the vertebral motion unit was not restored.<sup>22</sup> Recently, a novel system was introduced; an intervertebral bolt distracts and allows for facilitation of interbody fusion, and effective load sharing, and the polyaxial screws and clamps provide for stabilization.<sup>19</sup> Interesting clinical results follow the use of a customized device, to treat the cervical spondylomyelopathy in dogs.<sup>23</sup>

The cement was used in our patient because the bolts and cages were not available, and the spacers at our disposal were deemed too small. Customized devices were not offered as an option. Advantages of the cement were the potential to adjust its volume, according to the extent of the ventral slot, and to impregnate antibiotics.

We choose to use the PMMA plug mainly as a distraction device, hoping that it might result in early alleviation of symptoms, and that it might contribute to overall stability of the joint, during the early postoperative period.

Gentamicin's antimicrobial activity in PMMA after polymerization has proven to be good in cases of Gram + and *Pseudomonas* bacteria *in vitro* and is widely used in PMMA cement, beads and collagen sponges.<sup>14,15,24</sup> We presume that the local antimicrobial delivery of gentamicin contributed to eradication of the infection, as *Staphylococcus pseudintermedius* isolated was found to be sensitive to gentamicin. The dog was receiving amoxicillin–clavulanic acid prior to presentation to our centre. The results of culture and sensitivity from the blood and disc were not available to us at the time of discharge. We presumed resistance to amoxicillin–clavulanic acid; for that reason, we chose marbofloxacin as our first-choice antibiotics.<sup>25</sup> The pathogen was found also sensible to cephalexin. Cephalexin, during the first recheck, was added because of the difficulties in rising up reported by the owner. As our patient seemed to be still painful, and owners were



considering euthanasia, we felt marbofloxacin was not enough to treat the infection, and cephalexin was tried. We thought that multi-modal antibiotherapy would be more efficient in treating the infection.

We used the omentum because of its documented effectiveness in treating several infectious processes, with its rich network of arteries, veins and lymphatic vessels.<sup>17,26</sup> We believe that omentum's adhesion to the site sealed and cleaned the area, via angiogenesis, haemostasis and re-innervation.

Degenerative LS disease related to disc protrusion, with suspected early discospondylitis, was diagnosed prior to referral. The use of transarticular screws after dorsal laminectomy might not result in rigid fixation, because their placement involves only the articular facets stabilizing the dorsal compartment, whereas the two other compartments of the vertebral motion unit remain mobile.<sup>5</sup> Implant failure is reported in up to 30% of the operated dogs, and lack of improvement is seen in 23.5% of the population.<sup>5</sup> We presumed that in the presence of discospondylitis, there was an even higher risk of implant-related complications, as the bone purchase and tensile strength of implants were major concerns. Therefore, we did not use additional metallic implants to stabilize the joint, acknowledging that there might be residual instability, after our procedure.

Interbody fusion was not expected to occur in our case, due to the space occupying properties of the PMMA plug. The plug's position remained unchanged at last follow-up radiographs. We presume that fibrous connective tissue would fill the intervertebral space surrounding the plug.<sup>27</sup>

The lack of follow-up CT is a limitation of our report, as this modality might have provided more information about the anatomy of the LS joint, and might have helped determine the origin of the intermittent lameness reported during the first 6 months following surgery. We speculate that possible causes might be residual instability, impingement of the L7 nerve roots at the foramina, decreased mobility of the nerve roots due to local fibrosis and/or incomplete elimination of the infection.

The plug's contribution to the joint's stability is uncertain. Whereas it might augment stability of the ventral compartment, as a stand-alone device will probably fail to provide for long-term stabilization. Other distraction intervertebral devices, previously tested biomechanically for insertion at the LS space, might have been more appropriate in the present case. If revision surgery is required in the future, more robust stabilization systems should be considered.

In this clinical case, the PMMA-gentamicin impregnated plug, in addition to the surgical debridement, seemed to be an effective way for short-term distraction, potentially contributing, along with the appropriate antimicrobial therapy and analgesia, to alleviation of pain immediately after surgery and providing for a good short-term outcome. The use of cement plugs as sole devices in the LS joint warrants further study.

#### Author Contributions

Pierre Henri Moissonnier contributed to conception of study, study design, acquisition of data and data analysis and interpretation. Maria Manou contributed to study

design, acquisition of data and data analysis and interpretation. Aurélien Jeandel and Stéphane Blot contributed to acquisition of data and data analysis and interpretation. All authors drafted, revised and approved the submitted manuscript.

#### Conflict of Interest

None declared.

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