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

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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.

Introduction

Lumbosacral (LS) discospondylitis is an infection of the L7 to S1 intervertebral disc and the L7 and S1 vertebral endplates.1 Degeneration, which typically occurs at the LS junction,2 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.3 Pain, lameness and neurological signs are commonly reported.4 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.5 Several stabilization systems have

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

Case Description
A 7-year-old, 35 kg, entire male German Shepherd dog was
presented at Small Animal Hospital of the National Veter-
inary 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 stabiliza-
tion with transarticular facet screws. Medical treatment
started at the time of surgery included amoxicillin–clavu-
lanic 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 dete-
rioration occurred after antibiotic medications were discon-
tinued 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 unre-
markable. Blood culture was submitted. A CT scan (Brilliance
CT 64 Channel; Philips, Suresnes, France) was performed.
Aggressive osteolytic lesions of the caudal and cranial ver-
tebre 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 under-
taken 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.16 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 exami-
nation. A ventral slot was performed to the floor of the
vertebral canal. The width of the slot represented approxi-
mately 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 ⅓ 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. 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.
of the right gastroepiploic artery were ligated (bipolar electrosurgery). A part of the splenic portion of the greater omentum was cauterized, preserving the gastroplenic 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 U/1 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. Fusoidal culture was negative. Blood and tissue sample cultures were positive for *Staphylococcus pseudintermedius*, which was sensitive to marbofloxacin, cephalaxin, 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) 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.17–21 The use of distractable titanium cages and PMMA plugs in the cervical vertebrae is described in in vivo
studies; despite initial promising results, the techniques showed implant related complications, adjacent segment disease and high overall mortality rate at long-term.\textsuperscript{20,21} 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.\textsuperscript{18} Intervertebral spacers were reported to reduce space collapse in cervical vertebrae after disc fenestration \textit{in vitro}, but stability of the vertebral motion unit was not restored.\textsuperscript{22} 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.\textsuperscript{19} Interesting clinical results follow the use of a customized device, to treat the cervical spondylomyelopathy in dogs.\textsuperscript{23}

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 \textit{Pseudomonas} bacteria \textit{in vitro} and is widely used in PMMA cement, beads and collagen sponges.\textsuperscript{14,15,24} We presume that the local antimicrobial delivery of gentamicin contributed to eradication of the infection, as \textit{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.\textsuperscript{25} The pathogen was found also sensible to cephalaxin. 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 antibiotic therapy 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.17,26 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.5 Implant failure is reported in up to 30% of the operated dogs, and lack of improvement is seen in 23.5% of the population.5 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.27

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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