Canine Lumbosacral Spinal Fusion Techniques

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Background

The severity of clinical signs for dogs presenting with lumbosacral instability can vary. The patient's disease must be distinguished from other factors causing pain or neurologic impairment that localizes to the lumbosacral spine or pelvis. The diagnosis and treatment of lumbosacral instability can be challenging. Many dogs are successfully treated by surgical decompression alone.[1] However, as lumbosacral disease varies between dogs, decompression alone may not be adequate in some patients. Specific guidelines for the definitive diagnosis of instability do not exist. Often following imaging, the neurosurgeon is left asking, "To fuse or not to fuse?" It is the author's contention that in some patients, continued movement of the lumbosacral spine despite decompression will result in a failure of resolution of clinical signs. Of particular concern is that narrowing of the intervertebral foramen at L7-S1 will continue to cause nerve compression and subsequent pain. Fusion of the lumbosacral spine eliminates this dynamic source of nerve compression. Another mechanism for spinal nerve decompression is a foramintomy.[2] This procedure may provide adequate nerve decompression, but may be technically challenging and may contribute to instability.

Furthermore, lumbosacral fusion can be difficult to accomplish surgically due to anatomical constraints. There is a limited amount of bone available. The lumbosacral vertebral segment has unique characteristics that make implant placement challenging. Limited reports exist regarding techniques used to produce fusion at the lumbosacral space.[3,4,5,6]

Diagnosis

The diagnosis of lumbosacral instability is best accomplished with dynamic imaging of the lumbosacral spine. Flexed and extended lateral survey radiographs may serve as an important screening tool for lumbosacral instability. However, dynamic imaging of the lumbosacral spine with MRI or CT is our preference for the diagnosis of instability. Imaging of the LS spine has been well described.[7,8,9] The authors prefer CT for evaluation of the vertebrae and foramen. This type of imaging tends to be easier to perform compared to MRI. Positioning of the patient is less challenging. CT also provides excellent bone resolution. The patient's lumbosacral junction is imaged in flexion and extension. Axial images are reconstructed to evaluate and compare the position of L7 and S1 between extension and flexion. Compression of the nerve roots as they exit the foramen is evaluated on the images as well as signs of subluxation of the sacrum in relation to L7.

Surgical Technique

Several techniques have been described for stabilization of the lumbosacral spine.[4,5,6,10] These procedures may be biomechanically inadequate, technically challenging, or require expensive implants.[11,12] Most cases of lumbosacral instability have a protrusion of the degenerate lumbosacral intervertebral disk. Many patients also have circumferential compression from soft tissues and bony compression of the nerves as they exit the foramen. Because disk protrusion is often encountered, most surgical procedures for lumbosacral fusion involve a dorsal

laminectomy followed by a partial diskectomy with placement of a graft into the LS space once the disk has been removed. Implants are applied to L7 and S1 to maintain distraction and stabilization so bony fusion can occur. One reported technique for LS fusion is placement of screws through the articular processes of L7-S1.[4] Articular cartilage is removed from the facets and the articular processes are then stabilized using a positional screw. Cancellous bone graft should be placed around the articular processes to encourage fusion. A variation of this has also been reported using negatively threaded pins instead of screws through the articular processes.[5,6] These implants are under significant cyclical strain while the fusion is occurring and complications of these implants include bending, breakage and migration. In order to avoid cyclic fatigue of the implants, some surgeons place additional implants in the body of the L7 vertebra, sacral body and sometimes the ilium.

Novel Surgical Technique

The author's preference is to place the implants in locations not previously described. Implants are placed directly into the vertebral body, maximizing available bone purchase. This lessens the risk of implant failure due to loosening or breaking. For this technique the patient is placed on the table in sternal recumbency with the legs in a neutral position. A standard dorsal laminectomy is performed at L7-S1. The intervertebral disk is then partially removed and the endplates are curetted. Cancellous bone graft is placed into the intervertebral disk space to promote fusion. The laminectomy is extended to allow for clear identification of the sciatic nerve roots and the endplates of L7 and S1. Screws or threaded pins are placed across the L7-S1 articular processes. Positive profile threaded pins are then placed within the spinal canal. The nerve roots are retracted while these pins are being placed. Two pins are placed in the caudal endplate of L7 and two pins are placed in the cranial endplate of S1. The nerve roots are avoided and protected using a blunt Freer periosteal elevator or a nerve root retractor during the placement of the pins. The pins are cut so that they do not extend higher than the dorsal aspect of the spinous processes and epaxial musculature. Once the implants are in place, Gelfoam is placed over the nerve roots to protect them during the application and hardening of the PMMA. Careful technique is used when mixing the PMMA to minimize air bubbles. The PMMA is then applied over the pins dorsally to incorporate the implants. Following lavage, the incision is closed routinely. Radiographs are made most-operatively to evaluate implant and PMMA placement.

Potential complications of this technique include:

- Iatrogenic injury to the nerve roots or nerves as a result of implant placement and secondary to heat generated by PMMA
- Nerve compression secondary to implant placement within the spinal canal
- Implant loosening or breakage
- Infection
- Lack of fusion of the vertebrae
- Adjacent segment disease

To date the author has not experienced any significant complications with the use of this procedure. Fusion of the vertebrae may be difficult to definitively identify radiographically although clinically the dog shows no signs of complications. It has also been reported that in while some dogs have fusion of the LS space as a result of surgery, they may not have significant

improvement of their clinical signs.[12] Lumbosacral stenosis continues to present both diagnostic and therapeutic challenges. Undoubtedly refinements in our understanding of this disease will contribute to improvements in treatment.

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References

[1] Danielsson F, et al. Vet Surg 1999;28:91.
[2] Goedde T, et al. Vet Surg 2007;36:705.
[3] Auger J, et al. Vet Surg 2000;29:70.
[4] Bagley R. In Slatter, D(ed) Textbook of Small Animal Surgery (ed3) 2003;1238.
[5] Slocum B, et al. J Am Vet Med Assoc 1986;188:31.
[6] Slocum B, et al. In Bojrab, M(ed) Current Techniques in Small Animal Surgery (ed4) 1998;861.
[7] Jones J, et al. Vet Radiol Ultrasound 1995;36:91.
[8] Jones J, et al. Vet Radiol Ultrasound 1999;40:108.
[9] Goedde T. ACVIM Forum Proceedings 2007.
[10] Sharp N. In Sharp and Wheeler: Small Animal Spinal Disorders (ed 2) 2005;203.