

Thoracolumbar intervertebral disc herniation (IVDH) is a common disorder of the vertebral column mainly seen in chondrodystrophic dogs. Surgical decompression and removal of the extruded disk material is a widely accepted treatment modality, especially for disk extrusion. Disk protrusion typically occurs in nonchondrodystrophic larger breeds at older ages with chronic onset, but either type of disk herniation can occur in any breed of dog. Although thoracolumbar IVDH in dogs is one of the extensively documented diseases in veterinary neurology, information regarding long-term outcome is still insufficient. The goal of the study reported here was to evaluate a long-term clinical outcome, precise diagnostic evaluation methods and surgical procedures for Thoracolumbar IVDH.

2. Long-term neurologic outcome of hemilaminectomy and disk fenestration for treatment of dogs with thoracolumbar intervertebral disk herniation.

Objective—To determine the proportion of dogs with thoracolumbar intervertebral disk herniation (IVDH) that successfully recovered following hemilaminectomy and fenestration, the time to ambulation (TTA) in affected dogs after surgery, and the frequency of urinary and fecal incontinence in recovered dogs and to document long-term complications.

Design—Retrospective case series.

Animals—831 dogs with thoracolumbar IVDH treated by hemilaminectomy and concomitant disk fenestration by the same surgeon.

Procedures—For all dogs, neurologic deficits before surgery had been assessed with a modified grading system. Dogs were reexamined after surgery over a period of 3 to 6 months, and follow-up evaluation was performed at > 12 months. The proportion of dogs that neurologically improved after surgery, TTA, and incidence of fecal or urinary incontinence in recovered dogs were compared among dogs with various grades of neurologic dysfunction before surgery.

Results—Of 831 dogs, 122 had unsuccessful outcomes and 709 had successful outcomes. Of 620 dogs with intact deep nociception before surgery, 606 (97.7%) were ambulatory after surgery. Despite maintaining the ability to walk, 7 dogs were judged to have an unsuccessful outcome because the severity of ataxia did not improve. Of 211 paraplegic dogs with loss of deep nociception, 110 (52.1%) dogs became ambulatory after surgery. Long-term complications included incontinence, permanent neurologic deterioration, and self-mutilation. Dogs with paraplegia before surgery had a higher frequency of urinary or

fecal incontinence, compared with dogs that were ambulatory.

Conclusions and Clinical Relevance—Prognosis for dogs with thoracolumbar IVDH that retain deep nociception in at least 1 of the pelvic limbs or tail before surgery was good.

3. Effectiveness of Prophylactic Fenestration with Hemilaminectomy for Thoraco-lumbar Intervertebral Disc Extrusion.

Objectives- To determine the incidence and the location of recurrent thoraco-lumbar intervertebral disc extrusion (T-L IVDE) in chondrodystrophic dogs after hemilaminectomy with prophylactic fenestration (PF) and to document PF related complications.

Study Design- Retrospective study.

Sample population- 793 chondrodystrophic dogs.

Methods- Medical records of dogs that recovered from first hemilaminectomy and concomitant PF with >12 months follow-up were reviewed. The rate of recurrent T-L IVDE in dogs that underwent a second surgery and dogs with clinical signs that improved without surgery were evaluated. The rate of second disc extrusion (SDE) within T11-L4 intervertebral discs was compared between the PF discs and non PF discs.

Results- T-L SDE were surgically confirmed in 15 dogs (2.3 %), 2-61 months after the first surgery. No dog had recurrence due to further extrusion at the initial extrusion site. Sixty-one dogs had neurological deficits that improved without surgery (mean follow-up: 43.1 months). The SDE occurred at a PF disc (n=1), adjacent to the PF discs (n=8), non-adjacent to the PF discs (n=6). The risk of SDE in non PF discs was 26.2 times higher than that in PF discs (95% CIs 3.4 to 203.4; $P < 0.001$). Major PF related complications included iatrogenic introduction of the disc material into the spinal canal (n=1), and vertebral subluxation or instability (n=3) at 1-88 months postoperatively.

Conclusion and clinical relevance- Performing PF at spaces predisposed to disc extrusion significantly decreases the incidence of T-L IVDE recurrences. PF is a safe and effective treatment to prevent SDE in chondrodystrophic dogs.

4. Diagnostic Techniques and Surgical treatment for Thoracolumbar Intervertebral Disc Associated Dynamic Compression.

Objective: To describe the diagnostic findings, surgical technique and outcome in dogs with thoracolumbar intervertebral disc-associated dynamic compression.

Study Design: Retrospective case series.

Animals: Client owned dogs (n=11).

Methods: Medical records (2005–2010) of dogs with a stress myelographic diagnosis of spinal cord injury due to thoracolumbar intervertebral disc-associated dynamic compression with inconclusive compression in the neutral position that had hemilaminectomy and vertebral stabilisation were reviewed. Data on pre- and postoperative neurologic status, diagnostic findings, surgical techniques and outcomes were retrieved. Follow up clinical and radiographic evaluations were performed immediately, and approximately 1, 2, 6 months postoperatively, and at annual follow-up examinations.

Results: The stress myelography demonstrated distinct ventral dynamic compression due to bulging of the disc and additional dorsal compression due to infolding of the ligamentum flavum in some cases. The median percentage of post stress reduction in spinal cord height on lateral view was 18.0% (9.8-27.2%). All dogs recovered after surgery and remained ambulatory at follow up (median: 45 months, range: 7 to 94 months).

Conclusions and clinical Relevance: Thoracolumbar intervertebral disc degeneration may result in disc-associated dynamic compression. Stress myelography was an effective means of diagnosing this condition and hemilaminectomy with vertebral stabilisation was an effective treatment resulting in long term neurological improvement in all dogs.

5. Diagnostic Techniques and Surgical treatment for Spinal Canal Stenosis and Vertebral Instability caused by Congenital Thoracic Vertebral Anomalies.

Objective- To describe diagnostic findings, surgical technique and outcome in dogs with thoracic spinal canal stenosis and vertebral instability secondary to congenital vertebral anomalies.

Study Design: Retrospective clinical study

Animals: Dogs (n=9) with thoracic spinal canal stenosis.

Methods: Medical records (1995 – 1996; 2000 - 2006) of 9 dogs with a myelographic diagnosis of spinal canal stenosis and/or vertebral instability secondary to congenital vertebral anomaly that were surgically managed by vertebral stabilization with or without laminectomy were reviewed. Data on pre- and postoperative neurologic status, diagnostic findings, surgical techniques and outcomes were retrieved. Follow up evaluations were performed at 1, 2, and 6 months. Long term outcome was assessed by means of clinical examination or owner telephone interviews.

Results- Spinal cord compression was confirmed by myelography and in 2 dogs, dynamic compression by stress myelography. Eight dogs regained the ability to ambulate postoperatively. One dog with a partial recovery regained voluntary movement but did not become ambulatory.

Conclusions: Spinal cord injury secondary to congenital vertebral anomaly may have a good outcome when treated by vertebral stabilization with or without laminectomy. Adequate stabilization of the vertebrae and improved neurologic outcome was achieved in most dogs.

Clinical Relevance: Vertebral stabilization using positively threaded profile pins and polymethylmethacrylate with or without laminectomy is an effective treatment for spinal canal stenosis and vertebral instability secondary to congenital thoracic vertebral anomalies.

6. A Comparison of Thoracolumbar Intervertebral Disc Extrusion in French Bulldogs and Dachshunds and Association with Congenital Vertebral Anomalies.

Objectives- To compare data for French Bulldogs and Dachshunds that had hemilaminectomy for thoracolumbar intervertebral disc extrusion (T-L IVDE) by 1 surgeon and to evaluate the association between IVDE and congenital vertebral anomalies.

Design- Retrospective case series

Animals- French Bulldogs (n=47) and 671 Dachshunds.

Methods- Age, gender, vertebral anomaly, kyphosis/kyphoscoliosis, IVDE site, non-recovery and progressive hemorrhagic myelomalacia development from grade 5 (paraplegia without deep nociception) were compared between the 2 breeds.

Results- French Bulldogs were significantly younger ($P=.00001$), more likely to be male ($P=.023$), and more likely to have a congenital vertebral anomaly and kyphosis/kyphoscoliosis ($P<.00001$) than Dachshunds. The frequencies of French Bulldogs with IVDE within typical sites (T11-L3) were significantly lower ($P=.0005$) and within caudal sites (L3-L7) significantly higher ($P=.0001$) compared with Dachshunds. None of the French Bulldogs had IVDE within the kyphotic/kyphoscoliotic segment. The frequency of lumbar IVDE (L1-L5) in French Bulldogs with kyphosis/kyphoscoliosis was significantly higher ($P=.003$) compared with French Bulldogs without kyphosis/kyphoscoliosis. In grade 5 dogs, the risk of developing progressive hemorrhagic myelomalacia in French Bulldogs was significantly higher ($P=.03$) than in Dachshunds.

Conclusion - The distribution of IVDE site in French Bulldogs within the thoracolumbar and lumbar spine was different from Dachshunds. IVDE sites were not located at the sites of

vertebral anomaly. French Bulldogs appeared to have T-L IVDE at younger ages, with higher male predisposition and higher risk of developing progressive hemorrhagic myelomalacia from grade 5 compared with Dachshunds.

7. A comparison of molecular mechanism of intervertebral disc degeneration between French Bulldogs and Dachshunds.

Objectives- Intervertebral disc degeneration (IVDD) has a significant impact on the quality of life. The nucleus pulposus (NP) in chondrodystrophic dog breeds (CDBs) is similar to that in humans, because the cells disappear with age and are replaced with fibrochondrocyte-like cells. IVDD develops within the first year of life in CDBs. We previously reported that French Bulldogs (FB) appeared to have thoracolumbar intervertebral disc extrusion (T-L IVDE) at younger ages with higher male predisposition and higher risk of developing progressive hemorrhagic myelomalacia from grade 5 as compared to Dachshunds. However, the molecular mechanism underlying age-related IVDD is yet to be ascertained. The aim of this study is to investigate the molecular differences in IVDD between FB and Dachshunds.

Methods- Herniated disc material (HNP) was collected from FB and Dachshunds that underwent surgical treatment for intervertebral disk herniation at the Aikawa Veterinary Medical Center, Tokyo, Japan.

Results- Histological analysis showed a safranin O-positive area, and NP cells apoptosis was decreased in the HNP of FB as compare with that of Dachshunds. Real-time reverse-transcription polymerase chain reaction (RT-PCR) showed increased mRNA expression of Type 1 collagen and decreased levels of Type 2 collagen, aggrecan, and matrix metalloproteinase (MMPs) in the HNP of FB as compare with that of Dachshunds. **Conclusion-** These results suggest that a decrease in the degradation of extracellular matrix and an increase in production of fibrocartilage lead to total NP tissue volume increase in FB as compared with Dachshunds. This was considered to be the cause of early IVDH onset in FB.

In these study, we evaluated a long-term clinical outcome, precise diagnostic evaluation methods and surgical procedures for Thoracolumbar IVDH. Our results may contributes development of clinical management for Thoracolumbar IVDH.