CERVICAL ARTHROPLASTY IN DOGS WITH DISC ASSOCIATED CAUDAL CERVICAL SPONDYLOMYELOPATHY AND CERVICAL DISC HERNIATION. PRELIMINARY STUDY IN TWO CASES

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Objectives

1. To evaluate in dogs with cervical disc diseases the efficacy of an artificial disc designed for the dog cervical spine

Evaluation

a) Implant migration
b) Ability to maintain distraction over time
c) Mobility at the treated vertebral unit
Phase 1: design

Two endplates Stainless steel

a. In the center of inside surface of each endplate respectively:
   i. Concavity and convexity acts like a ball and the socket.

b. External surface of each endplate:
   i. convexity to prevent implant migration
   ii. concentric grooves to allow bone in growth into the implant.

Patent # US2008/0306597 A1
- **Two breakable fins** attached to the dorsal portion of each end plate:
  
  **TO FACILITATE HOLDING AND PLACEMENT OF THE IMPLANT**

- **Breaking point of the fins** at the attachment to each end plate.

- **Once the disc is implanted** the fins are detached from the prosthesis by twisting each fin along its long axis.
Phase 2: *in vitro* biomechanical testing

- In vitro Biomechanical Comparison of Cervical Disc Arthroplasty, Ventral Slot Procedure, and Smooth Pins with Polymethylmethacrylate Fixation at Treated and Adjacent Canine Cervical Motion Units


1) 4 Groups of 6 cervical spines
2) Treated Vertebral Space C5-6
3) Prosthesis, Ventral Slot, Pin+PMMA fixation, and normal spine
Overall the artificial disc was better able to mimic the behavior of intact spine compared with ventral slot and Pin+PMMA groups.

Effect of cervical level on the mechanical properties of each group (1-way-ANOVA) and effect of group at each cervical level (repeated measure ANOVA). Difference significant at a probability level of 95% (p<0.05).
Phase 3: pilot clinical study

Titanium alloy (Ti 6Al-4V ELI)

Including criteria
- Two owned client dogs with cervical disc disease
- Weight
  - no less than 50 lb (22 kg)
- Diagnosis:
  - history, clinical signs, confirmed on MRI
- MRI: 1.5 T magnet and cervical spine array coil
  - T1,T2 weighted images, Proton density, Flair
  - Sagittal and transverse plane + sagittal traction
- MDB:
  - CBC, Chemistry panel and Thoracic radiographs
- Consent form and study participation agreement
**Treatment**
- Spinal decompression by Ventral slot + Implantation of the prosthesis
- 6 wks neck brace + restricted activity

**Follow-up**
- Serial X-rays
  - Time 0, 2 - 6 wks, 3 – 6 months and 1 year
  - VD, LL, stress views (traction, dorso/ventral flexion)

**Rescue plan**
- Migration of device, radiological signs of infection, and persistent neurologic signs,
  - a course of NSAID +/- antibiotic therapy
  - removal of the prosthesis w conversion to standard ventral slot if medical management not effective
• **Sizes of the prosthesis.** 6 different sizes.

<table>
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<tr>
<th>Disc</th>
<th>A (mm)</th>
<th>B (mm)</th>
<th>C (mm)</th>
<th>D (mm)</th>
<th>E (mm)</th>
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<td>10.5</td>
<td>7.4</td>
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<td>11.3</td>
<td>8.5</td>
<td>7.8</td>
<td>5.9</td>
</tr>
</tbody>
</table>

A: assembled width; B: outside diameter; C: width of the flat; D: thickness of the convex part; E: thickness of the concave side.
Implant Size Selection:
**Dog 1**

- 4 y old M intact Doberman Pincher, 31 kg
- Acute onset cervical pain & ataxia
- Neuro-exam
  - Cervical pain, ataxia

**MRI:**
- Acute myelopathy 2\textsuperscript{ary} to C6-C7 Disc Herniation
Dog 2

- 8 y old MN Labrador Mix, 23 kg
- 4 months progressive ataxia/tetraparesis
- Neuro-exam:
  - Cervical pain, amb. tetraparesis, CP deficits all 4 limbs

- MRI:
  - Chronic myelopathy 2 ary to C5-C6 disc disease
  - + dorsolateral encroachment of the spinal cord
Surgical technique

Ventral slot and spinal decompression
Placement of Caspar cervical retractor
• Maximal distraction
• Milling each vertebral end-plate with burr to create a concavity shape
• Placement of the prosthesis
Maximal DISTRACTION
Distraction released
Fins are twisted and de-attached from the implant
The Caspar retractor is removed before closure
- time 0: immediate post-op

Dog 1

Dog 2
- **2 weeks post-op**

**Dog 1**
- Neutral
- Linear traction

**Dog 2**
- Neutral
- Linear traction
- **3 months post-op**

  Dog 1
  - Neutral
  - Linear traction

  Dog 2
  - Neutral
  - Linear traction
6 months post-op

Dog 1

Neutral

Linear traction

Dorso-flexion

Ventro-Flexion
6 months post-op

Dog 2

Neutral

Linear traction

Dorso-flexion

Ventro-Flexion
12 months post-op  Dog 1

Neutral
Linear traction
Dorso-flexion
Ventro-Flexion
Results: clinical outcome

- **Dog 1**
  - Complete neurologic recovery, with two occasional episodes of cervical pain during the first 2 wks post-op, resolved with NSAID.
  - up to 12 month re-check:
    - Neurologic normal

- **Dog 2**
  - Improved during the first 2 months post-op, less ataxic and less CP deficits.
  - 6 month post-op:
    - mild ataxia without CP deficits except for mild delayed in hopping reaction on left front limb
Results: X-Rays

- Immediate post-op X-rays:
  - implant was well seated in the slot providing good distraction.

- In all post-op X-rays:
  - distraction was maintained with no evidence of ventral bridging spondylosis at the treated site.

- Not migration and not signs of infectious

- Mild degree of mobility at the treated site 1 year post-op in Dog 1, which decreased over time
Conclusions

- Cervical arthroplasty was well tolerated in both dogs, maintained distraction and prevented bridging spondylosis.

- Limitations:
  - Number of cases treated
  - Different type of discs cervical diseases treated

- This procedure is promising and warrants further study
Latest Updates

New bur custom made to match the convexity shape of the external surface of the implant.

The two fins have been replaced by two octagonal pins screwed in each shelve of the implant. The pins are easily unscrewed from the prosthesis after implantation.

Barrol-holder for handling the prosthesis during implantation.
Acknowledgments

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  - Biomechanical testing
- Mark Markel
  - Statistical analysis

**Bay Area Vet Specialists**

- First clinical study

**East Bay Area Veterinary Specialists**

**Sequoia Animal Hospital**

- On going clinical study