CT-based evaluation of paraspinal musculature in small breed dogs with and without atlantoaxial instability

A Müller[1, 2], F Forterre[2], B Vidondo[3], MH Stoffel[4], AM Hernandez-Guerra[5], IN Plessas[6], MJ Schmidt[7], C Precht[8]

[1]Tierarztpraxis Emmevet AG, Hasle-Rüegsau, Switzerland; [2]Division of Small Animal Surgery, and [8]Clinical Radiology, Department of Clinical Veterinary Medicine, and [3]Department of Clinical Research and Veterinary Public Health, Veterinary Public Health Institute, and [4]Division of Veterinary Anatomy, Vetsuisse Faculty, University of Bern, Bern, Switzerland; [5]Department of Veterinary Medicine and Surgery, Universidad Cardenal Herrera-CEU, CEU Universities, Valencia, Spain; [6]Davies Veterinary Specialists Limited, Herts, United Kingdom; [7]Clinic for Small Animals, Department of Veterinary Clinical Sciences, Justus-Liebig-University Giessen, Giessen, Germany.

Introduction

Atlantoaxial instability (AAI) is a common condition among small breed dogs. While the importance of ligamentous structures in AAI is well described, the role of the musculature is still poorly understood.
Aim: to evaluate differences in

- paraspinal muscle area and
- force distribution

between dogs with and without AAI using CT images.

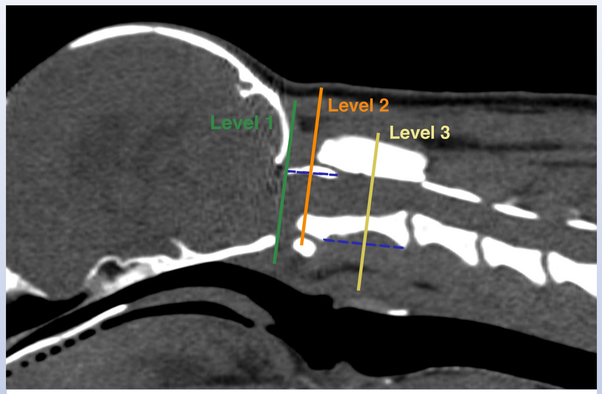

Figure 1: *Sagittal reconstructed CT-image showing the localization of the three different levels where measurements were performed. Level 1: Occiput/C1, Level 2: Center of the dorsal arch of C1, Level 3: Center of the vertebral body of C2*

Materials & Methods

- Retrospective multicenter study
- 83 small breed dogs
  - 34 dogs with AAI
  - 49 control dogs

CT images were analysed at three levels (Fig. 1) for the following variables to describe force distribution and paraspinal muscle cross-sectional area (Fig. 2, 3)

Materials & Methods

Variables:

- Ratio of moments (ROM)
- Dorsal-to-ventral muscle-area ratios (d-v-ratio)
- Ratios of the dorsal and ventral musculature to C2 height (d-C2-ratio and v-C2-ratio)

Statistics: differences between groups (affected and control) were evaluated using MANOVA ($p<0.05$) taking the head-neck-position (two subgroups: flexed and neutral-extended) into account.

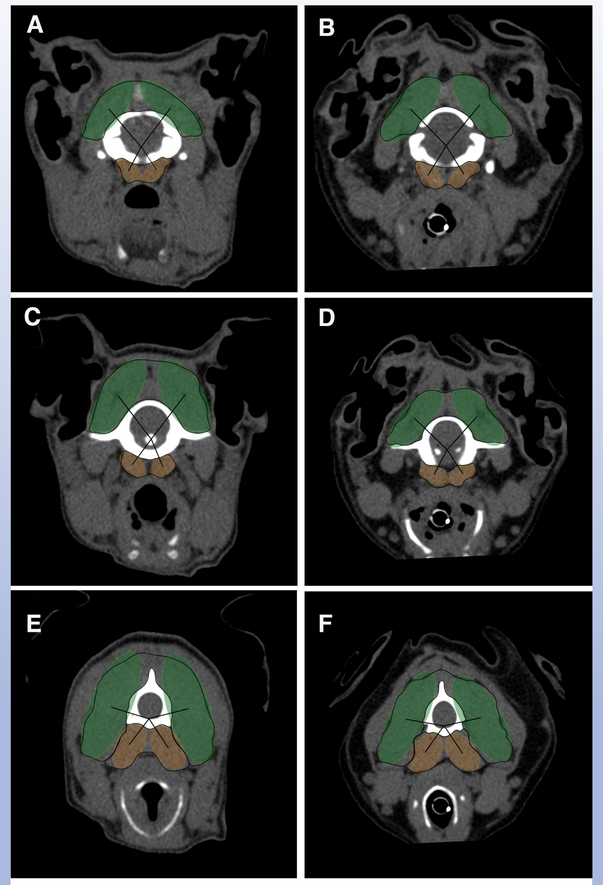

Figure 2: Transverse reconstructed CT images of a patient from the control (A, C, E) and affected (B, D, F) group, respectively, at levels 1 (A and B), 2 (C and D) and 3 (E and F) illustrating the ratio of moments (ROM) as a measure of the force distribution

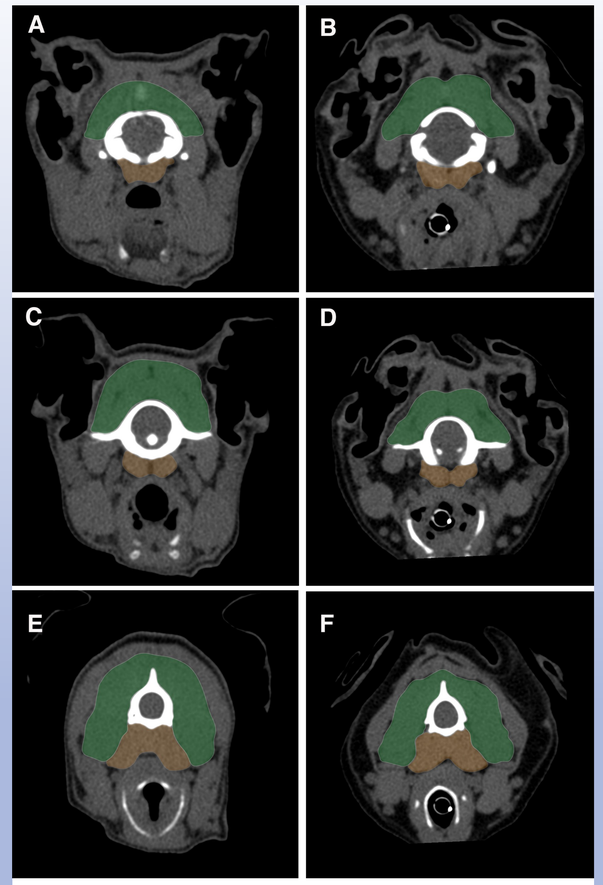

Figure 3: Transverse reconstructed CT images of a patient from the control (A, C, E) and affected (B, D, F) group, respectively, at levels 1 (A and B), 2 (C and D) and 3 (E and F) illustrating the cross-sectional muscle area used to calculate the d-v-ratio, the d-C2 ratio and the v-C2 ratio.

Results

Significant alterations in dogs with AAI, if flexed and neutral-extended subgroups were analysed together:

- Lower ROM at all levels (Fig. 2)
- Lower d-v-ratio at levels 2 and 3 (Fig. 3)
- Smaller dorsal paraspinal muscle area (d-c2-ratio) at level 2 (Fig. 3)

The head-neck-position had a significant influence on:

- ROM and d-v-ratio at all three levels
- D-C2-ratio at level 1

Significant alterations in dogs with AAI, if flexed and neutral-extended subgroups were analysed separately:

- Lower ROM at levels 1 and 2 for both head-neck-position
- Lower d-v-ratio at level 2 for flexed head-neck-position, only.

Conclusion

- Results showed a limited role of muscle hypertrophy/atrophy in dogs with AAI
- Consistent changes in paraspinal musculature area in small breed dogs with AAI compared to unaffected individuals could not be demonstrated
- Results confirm altered force distribution in dogs with AAI in the area of the AA joint
- Head-neck-position has a significant influence and should be taken into account when evaluating neck musculature