INTRODUCTION
Chondrodystrophy is a genetic disorder where the presence of one or more copies of the fibroblast growth factor 4 (FGF4) retrogene on chromosome 12 (CFA12) are apparent (1). Chondrodystrophy results in shortened limbs and inappropriate calcification of intervertebral discs contributing to intervertebral disc disease (IVDD) while also increasing susceptibility to disc herniation (1,2,3). The Nova Scotia Duck Tolling Retriever (NSDTR) breed has been used to study IVDD while also influencing skeletal development. The purpose of the geometrical analysis of several vertebrae is to determine whether chondrodystrophy impacts vertebral geometry, just as it impacts the growth of long bones. The analysis of disc mineralization is to determine whether the presence of 1 or 2 copies of FGF4 on CFA12 leads to multifocal disc mineralization.

STUDY DESIGN
The NSDTR breed was selected due to their distinct appearance, gait, and mechanical properties in chondrodystrophic dogs. Clear differences in IVD mineralization among dog groups were confirmed.

METHODS
The NSDTR breed has been used to study IVDD while also influencing skeletal development. The NSDTR breed was selected due to their distinct appearance, gait, and mechanical properties in chondrodystrophic dogs. Clear differences in IVD mineralization among dog groups were confirmed.

RESULTS
For C3, the canal height to width ratio was larger for 2 copies (0.86) of the FGF4 retrogene compared to no copies (0.83) (p=0.033). The effect on size was a modest difference. For T13 vertebrae, endplate angulation was lower in dogs with 1 copy of FGF4 copy (8°) than no copy (12°) (p=0.008). The effect on size was a modest difference. Statistical trends (0.05 < p < 0.10) were seen in C3 canal height, C3 transverse process length, and T13 endplate angulation.

SUMMARY
Differences in canal geometry and endplate angulation were identified which can contribute to the overall appearance, gait, and mechanical properties in chondrodystrophic dogs. Clear differences in IVD mineralization among dog groups were confirmed.

CONCLUSIONS & FUTURE DIRECTIONS
Computer aided design (CAD) software is a powerful method to analyze geometric variation in both long and short bones. 3D analysis of the canine spine with the use of CAD software is state of the art because there are currently no published 3D analytical methods of the canine spine or qualitative analysis of canine disc mineralization. Specific changes in angulation will be corrected with the changes in angulation detected in the radius of dogs with 0, 1, or 2 FGF4 copies on CFA12. These correlations will enhance our understanding of the impact of FGF4 on endochondral and intramembranous ossification. These discoveries open the door to analyze further spinal and canal geometry in this skeletal disease and other skeletal diseases. These early findings will be reviewed and discussed with neurosurgeons.

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