COMPUTER SIMULATION OF DOG SPINE IN VETERINARY SURGERY

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Introduction

Computer simulation and mathematical modeling are modern and dynamically developing methods already used for several years in various sectors of human medicine. In the field of veterinary medicine are those methods so far unique on a global scale, but simultaneously unique with high potential for use in both research and clinical applications. The main advantage of modeling is a relatively fast and inexpensive verification of a predetermined set of mechanical hypothesis without performing an expensive experiment in vitro or in vivo.

At the Department of surgery and orthopaedics, Dogs & Cat Clinic, VFM Brno are computer modeling methods used for the study of basal research of biomechanical properties of the cervical spine of dogs in case of surgical therapy of Wobbler syndrome.

Material and Methods

A mathematical model was created from a complete scanning of the cervical spine a Doberman dog in general anesthesia with wobbler syndrome on the multi-detector computer tomography LightSpeed 16 (GE, Milwauke, USA). The images were made in helical mode with a width of cut, 0, 625mm (pitch 0,562). This data was then processed by computer software (Mimics, Materialise HQ, Belgium) and of a series of CT images was created by a real 3D model of the cervical spine. To this basic rough model was subsequently defined the basic physical characteristics of the vertebrae (bone tissue), intervertebral discs, articular facet joint structures and ligaments stabilizing the individual vertebrae (lig. longitudinale, ventrale, dorzale longitudinal lig., lig. flavum, supraspinale lig., lig. interspinale). Created model maintains the physiological condition and properties of soft tissue. Model of the cervical spine of a dog with Wobbler's Syndrome was used to monitor performance changes during movement of the cervical spine (lateroflexion, ventroflexion, extension, rotation) after the implementation of the indirect decompression of the spinal cord by the traction method and stabilization of the cervical vertebrae.

Results

Numerical analyses were made by the ABAQUS software (Dassault Systemes, France), using the finite element method (FEM). The stress and strain in each part of the model of the cervical spine and implants were monitored. The aim of this numerical study was to assess the impact of the implantation of intervertebral distraction spacers and screws in the different levels of the cervical spine on its mobility and stability. In the kinematic studies of computer model was also monitored by the size of the forces needed to carry out the motion.

Discussion & Conclusion

The obtained data indicate that the computer model is very simplified component compared to a dog cervical spine in nature, but very authentically copies the behavior of the cervical spine in case of kinematic analysis. An invaluable tool for the verification of mechanical properties of a wide range of combinations can be obtained after connecting the model with the type of surgery. The behavior of the system depending on the surgical procedure (change of implant placement, change the direction of the implant, the number of implants) and material composition implants van be monitored. For clinical applications it is valuable information that sac assist to the surgeon in finding the most advantageous procedure of surgery in relation to optimal biomechanical properties.