21-23 October, Vilnius, Lithuania
13th International Conference
BIOMDLORE 2021

Investigation of the mechanical properties of spayed canine vertebrae under the external load

Ernest Kostenko[1], Rimantas Stonkus[2], Jakov Šengaut[3], Algirdas Maknickas[1]

Department of Biomechanical Engineering, Vilnius Gediminas Technical University, Lithuania[1]
Department of Mechatronics and Robotics and Mechanical Engineering, Vilnius Gediminas Technical University, Lithuania[2]
Jakov Veterinary Clinic, Lithuania[3]

ABSTRACT

BACKGROUND: All around world, degenerative spine illnesses are a big issue. According to the World Health Organization, osteoporosis is a global public health issue that causes bone loss, which leads to fracture and an increased risk of fracturing. As a result, mechanical analysis of vertebrae can reveal more about the development of osteoporosis.

OBJECTIVE: The goal of this research is to investigate the mechanical behaviour of a neutered eight-year-old canine's lumbar spine vertebras, a carcass we received adhering to all bioethical norms from a veterinary clinic where dog owners decided to euthanize her due to a spreading mammary tumour and agreed to donate the carcass for the educational purposes.

METHODS: Our study procedure was split into separate stages, including collecting samples carefully, processing spine specimens, evaluating mechanics, and analysing errors using Computed tomography scan images length and surface-area data.

RESULTS: When calculating the area of the overloaded surface, the L2 vertebra has had the biggest area (176 ± 16; 177 ± 3), and the L7 vertebra had the lowest (156 ± 4; 151 ± 33). The shortest distance observed was 15.17 ± 0.93 between the first and final lumbar vertebrae (L1), whereas the longest distance obtained was 19.8 ± 3.7 between the L3 and L4 lumbar vertebrae. Mechanical tests on three vertebrae were done, and a big difference was observed in the first cycle of the first sample. Finally, the spine data were used to determine the mechanical load, pressure, and stretch relations of specimens, and to develop analytical curves characterizing recorded pressure-stretch relationships.

CONCLUSIONS: For modelling the pressure-stretch relationship of the vertebrae under cyclical loads, second-order polynomials for displacement and seventh-order polynomials for pressure were proposed. Comparisons of the empirical data and the suggested cyclic modelled curves indicate a high level of correlation.

KEYWORDS: canine, lumbar, vertebrae, osteoporosis, spine.