

Biomechanical tests on long-bone elliptical medullary-canal endoprostheses for limb salvage in dogs

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Abstract-

Exo-endoprosthesis is a limb salvage procedure poorly described for animals, as only expensive metal devices have been used so far. Currently, additive manufacturing (AM) can make this type of implant affordable by exploring a wide new range of materials. However, safety factors should be considered and could be related to kinetic and kinematic studies of canine natural gaits. The suitability of a novel inner part of an exo-endoprosthesis manufactured by fuse deposition modeling (FDM) was assessed for long canine bones with an elliptical medullary canal. Polyether ether ketone (PEEK) was the material used as an alternative to metal for veterinary traumatology. Poisson's ratio of 3D-printed PEEK material and ex vivo mechanical tests of the customized endoprosthesis were performed for the evaluation. The customized endoprostheses had promising outcomes for the radii of 20 kg dogs. Quasistatic mechanical tests of bone-inserted endoprostheses—pure compression tests—reached a maximum force of 1045.0 ± 78.0 N. In fatigue tests, the samples reached 500,000 cycles without failure or detriment to their quasistatic results. These outcomes surpass the natural weight-bearing of dogs, even during a galloping pace. Furthermore, torque tests with different adhesives were performed to obtain reference data for future assessments comparing with natural dog movements.

Index Terms- biomechanical test; torsional test; FDM; PEEK; exo-endoprosthesis; ex vivo; radius; canine

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Citation:

Mendaza-DeCal, R.; Ballesteros, Y.; Peso-Fernández, S.; del Real-Romero, J.C.;

Rodríguez-Quirós, J. "Biomechanical tests on long-bone elliptical medullary-canal endoprotheses for limb salvage in dogs", Animals, vol.12, no.21, pp.3021-1-3021-15,

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