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Research paper

Thiel-fixation preserves the non-linear load–deformation characteristic of spinal motion segments, but increases their flexibility

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ABSTRACT

Human cadaveric specimens are recommended as the best option for in-vitro tests. However, fresh human spine specimens are often difficult to obtain. Further problems are the potential risk of infection and they can only be used over a limited test period. Therefore, the use of embalmed specimens is often discussed. The most common method is formalin fixation. However, this type of embalming can result in failure, because the biomechanical properties of the tissue is partially influenced. In recent years the development of the new method, the fixation according to Thiel, could provide an alternative to fresh or formalin-fixed specimens. The aim of the present study is to compare the biomechanical properties between fresh and Thiel-fixed spine specimens, and to compare the data to previous data of a test with formalin fixation.

For the study, six L1–L2 spinal segments from 16-week-old calves were biomechanically tested. The parameters, range of motion and neutral zone, were determined in flexion/extension, right/left lateral bending and left/right axial rotation.

The results showed that the specimens kept their non-linear load–deformation-characteristic after Thiel fixation. The range of motion of Thiel-fixed specimens increased relative to the unembalmed state by approximately 22% in flexion–extension, 23% in lateral bending ($p < 0.05$) and 45% in axial rotation ($p < 0.05$).

In conclusion, the results still suggest a preference for fresh cadaveric spine specimens for quantitative biomechanical in-vitro testing, because they provide the best physiological conditions. However, for preliminary tests, which may only be used for orientation, embalmed specimens using the Thiel fixation method might serve as an alternative. Compared to formalin-fixated specimens which become approximately 5 times stiffer and completely lose their non-linear load–deformation-characteristic, as found in a previous study; the Thiel fixation maintains the non-linear load–deformation-characteristic but increases the range of motion.

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