WHAT IS THE EFFECT OF THE BALL-SOCKET ARTIFICIAL DISC ON THE SPINAL KINEMATICS? – COMPARATIVE ANALYSIS

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Introduction

A problem of a low back pain is one of a great problem of present civilization. The degeneration of intervertebral discs is getting more frequent problem of ageing population [Adams, 2006]. There is a problem with a design of mainly used artificial discs [Otáhal, 2008]. Therefore, the better understanding of intervertebral joint behavior before and after the artificial discs implantation is necessary. There is one possible approach for solution of that problem, which is in study of the intervertebral kinematics. It seems that the description of kinematics through the usage of helical axis is recommended [Wachowski, 2009]. The porcine lumbar spine was used as a model of human spine.

Method

For the testing of the spinal kinematics the L3-L5 section of the porcine spine was used. There were tested 9 samples from animals of age between 2/3 and 2 years.

A motion of particular vertebras was measured by means of a motion capture method based on the commercial system Qualisys. At first, the bottom and upper vertebra were fixed in a cylindrical cast. The segment was connected to the loading mechanism. The positions of three significant points (on processes) on each vertebra were for vertebra coordinate system determination. Than the periodic quasistatic loading with amplitude 10° in flexion - extension was applied and the motion was recorded with 50fps. This procedure was repeated after implantation of ball-socket type of artificial disc.

Then the movement of each vertebra was descripted by helical axes. Commercial software MATLAB was used for evaluating the centers of rotation. The outputs were vectors, which described the positions of centers of rotation in local coordinate for each vertebra movement. The global coordinate system was defined on the loading device.

Results

The positions of instantaneous centers of rotation of healthy porcine spine, during flexion-extension are located in a small round area in upper section of boundary between vertebral body and spinal canal. In comparison with this findings, the area of locations of instantaneous centers of rotation of the porcine spine after implantation of ball-socket type of artificial disc, much more expands into the vertebral body as well as into spinal canal and is much more bigger than in case of healthy spine.

Conclusion

The area of instantaneous centers of rotation of healthy spine is located in order to protect the spinal cord, it is necessary to respect that fact in development of new artificial discs. From experiments with ball-socket artificial disc ensure, that this type of artificial disc badly follows the native kinematics of intervertebral joint that may cause an overload of some elements of intervertebral joint. like Zygapophyseal joints. The ball-socket spinal implants have also negative effect on neighboring intervertebral joint kinematics, which can cause an overload of some elements of this intervertebral joint.

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