EFFECT OF SPINAL STABILISATION ON INTRADISCAL PRESSURE IN CERVICAL SPINE

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Introduction
The aim of this work was analysis of the stabilisation influence on intradiscal pressure. The investigations were focused on the cervical region of spine, because this is a very common site for injury. It is caused of relatively big range and significant frequency of movements. Some of diseases need the application of the spinal fixator which changed the pressure of the adjacent region. Pressure within intervertebral discs is often analysed in single lumbar movement segment [1], rarely it is investigated in longer part of spine particularly in cervical spine [2],[4]. There is not much experiment which shows influence of the stabilisation on intradiscal pressure.

In this work was investigated the changes of pressure within cadaveric nucleus pulposus of cervical intervertebral disc. The tests were made on intact and stabilised spines.

Material and method
Twelve cervical spines (C3-C6, age 24-83) were used for this biomechanical testing. The spine samples were stripped of soft tissues, sparing the ligaments and articular structures. Radiographic and computer tomography examination of the specimens showed normal, no degenerative changes and no deformity or anatomic defects. All biomechanical testing were performed on a uniaxial material testing machine (MTS 858 Mini Bionix Test System), in a non-destructive manner [3].

The loading types proceeded according to pattern: each specimen was testing in two tests: axial compression and bending (flexion/extension). In axial compression, the specimens were subjected to 200N with a compressive preload 50N. In bending test a displacement was used to control it, the range of displacement was +/-15 mm. Figures 1 and figure 2 shows the set-up systems for compression and bending.

The biomechanical testing sequence of the spinal structures was as follows: each specimen was first tested intact, subsequently, the specimen was destabilised, then reconstructed by using: bone graft (Cloward or Robinson-Smith technique), graft and anterior fixator plate.

During each biomechanical test, intervertebral disc pressure measured by a strain-gauged pressure transducer mounted in needle. The transducers were inserted into intact disc below and above planning and performed stabilisation.

Results
The exemplary results of intradiscal pressure analysis under axial compression load are showed on Figure 3, 4 and in bending test on Figure 5,6. Investigations prove that difference of pressure in nucleus pulposus for healthy spine and after stabilisation are not significant. Stabilisation of one segment causes a removal of one of important movement joint. In consequence of that change of range of movement appears in the part above and below stabilised part and, what is connected, in the changes of recorded pressure.
The results of investigation confirm linearly related to the applied compressive loads. This study has shown that intradiscal pressure is always inferiority in disc above stabilisation segment than disc below (even 49%) – regardless of investigated system (intact spine or spine with fixator). Intradiscal pressure in spine with bone graft, using Cloward technique or Robinson-Smith techniques, has not shown significant differences between these two methods of stabilisation. Additionally stabilisation (in the form of fixator plate) has also not shown essential influence of fixator on changing intradiscal pressure.

A typical run of pressure curve in the bending loading function are presented in Figure 5. Mean pressure values in flexion exceed those of extension for both physiological system and after stabilisation. However, the most significant differences between simulated loads appear after stabilisation inserting. During bending test the pressure in the segment below (P2) the planned and performed stabilisation is always higher then in segment above (P1) and this principle is observed in both for the system before and after implants insertion.

Discussion

The presented work showed the technique and methodology of low-invasive pressure measurement in intervertebral disc in cervical spine. Analysis of pressure distribution in the segments above, the planned and next performed stabilisation, in relation to the segments below indicates significant differences. Results of investigations confirm long-time clinical observations, that the application of spinal implants caused degeneration of the intervertebral discs in adjacent segments, especially below the stabilisation.

References


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