Introduction.– To correct the spine sagittal imbalance, lumbar orthoses are commonly prescribed as conservative treatment of low back pain. These devices could affect the distribution of loads among passive and active lumbar subsystems. However, with only one study in this field proposed by Nachemson et al (1983), their biomechanical action such as the reduction of the intradiscal pressure (IDP) remains unknown and controversial. The goal of this study was to investigate the IDP change induced by a rigid lumbar orthosis from a new non-invasive measurement method.

Method.– From the comparison of two radiographs EOS™ (Biospace, Paris) with and without a lumbar orthosis, the displacements and rotations of each vertebra were calculated and implemented in a patient-specific finite element modelling. The IDP measurements along each lumbar disc were extracted with a precision of ± 2.5 Pa.

Twenty patients were tested in standing or sitting posture with a semi-rigid lumbar orthosis Lordactiv™ (Ormihl-Danet, Villeurbanne) in two conditions: with or without a curved rigid lumbar part.

Result.– A curved rigid lumbar part was necessary to obtain significant IDP distribution change along the anteroposterior direction. Interestingly, an IDP decrease appeared in some patients until –50 Pa. However, the IDP change appeared very posture, disc level and patient-dependent ranging from –50 to +8 Pa.

Discussion.– An IDP distribution change reveals a different load sharing between posterior elements and intervertebral discs whereas decompression only could be explained by a decrease muscle activity. Especially, the intradiscal elasticity (age-dependent) and the lumbar back adipose tissue thickness are the main variables correlated with the interindividual differences.

Conclusion.– These results demonstrated that wearing a rigid lumbar orthosis can significantly influence the stress-strain values in diseased discs, provided that the patient is kept an sufficient elasticity.

Further reading

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http://dx.doi.org/10.1016/j.rehab.2012.07.706

CO22-009-e

New non-invasive and patient-specific method allowing intradiscal pressure change measurement induced by lumbar conservative or surgical treatments

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Keywords: Intervertebral disc; Pressure; Load; Finite element; Low back pain

Introduction.– Mechanical loads on the spine appear to play a major role in the etiology of low back pain. Unfortunately, little is known about the intradiscal pressure change associated with conservative or surgical treatments. Direct and indirect measurements are mainly limited respectively by the invasiveness and by the patient-specific calibration of the finite element modelling. The goal of this study was to develop a new non-invasive and patient-specific method allowing lumbar intradiscal pressure change measurement induced by conservative or surgical treatments.

Method.– According to an adaptation of the Catmull-Rom Splines method validated by McCane et al. (2006), the displacements and rotations of each vertebra were measured from the comparison of two radiographs EOS™ (Biospace, Paris) before and after treatment. The elastic modulus of each disc was calibrated from the comparison of two radiographs non-loaded and loaded with 4 kg on each shoulder of the patient. A finite element model was created from the radiograph without treatment. Finally, the kinematic of each vertebra and the elastic modulus of each disc were implemented in this model, from which the pressure measurements along each lumbar disc were extracted.

To determine the precision of this method, the accuracy of ± 0.7° and ± 0.285 mm reported by McCane et al. (2006) for the kinematic measurement was simulated in the model created from a clinical case.

Results.– The mean intradiscal pressure precision measured along the disc was ± 2.5 Pa.

Discussion.– The precision appeared sufficient to measure a clinically relevant change of pressure in the lumbar disc after treatment. The main advantages of this method are the inclusion of the differences of geometry and elasticity between each level of the lumbar disc and for each patient. Thus, the effectiveness of the treatment can be interpreted in light of the remaining level of discal elasticity.

Conclusion.– This method could help to measure effective intradiscal pressure to better understand and improve conservative or surgical treatments of low back pain.

Further reading

McCane B., King T.I., Abbott J.H., 2006. Calculating the 2-D motion of lumbar vertebrae using splines. Journal of Biomechanics;39: p. 2703–08.

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